WIRE AND WIRE PRODUCTS

JUNE 1948

AIR COOLED
-inside
and outside

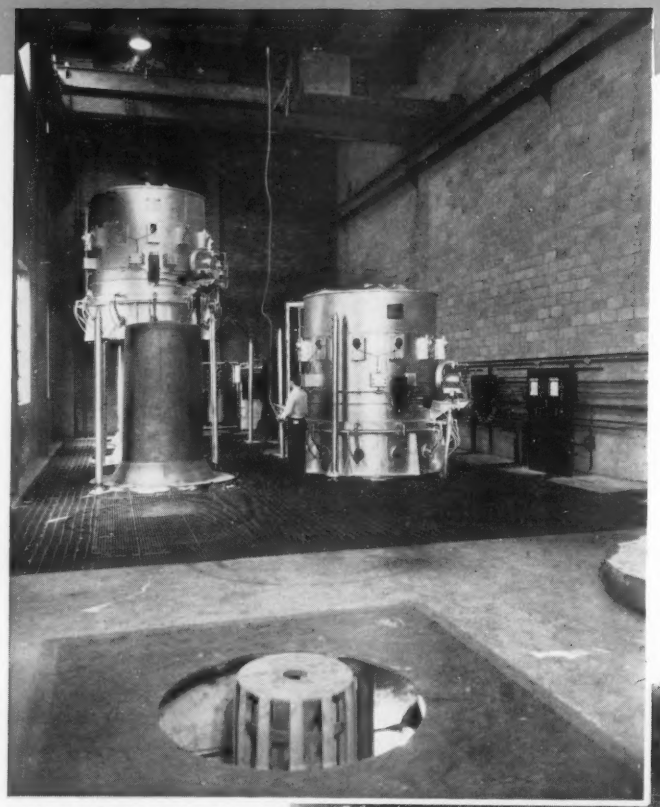
MORGAN
CONSTRUCTION CO.
WORCESTER, MASSACHUSETTS

MORGAN
CONNOR
WIRE MACHINES

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

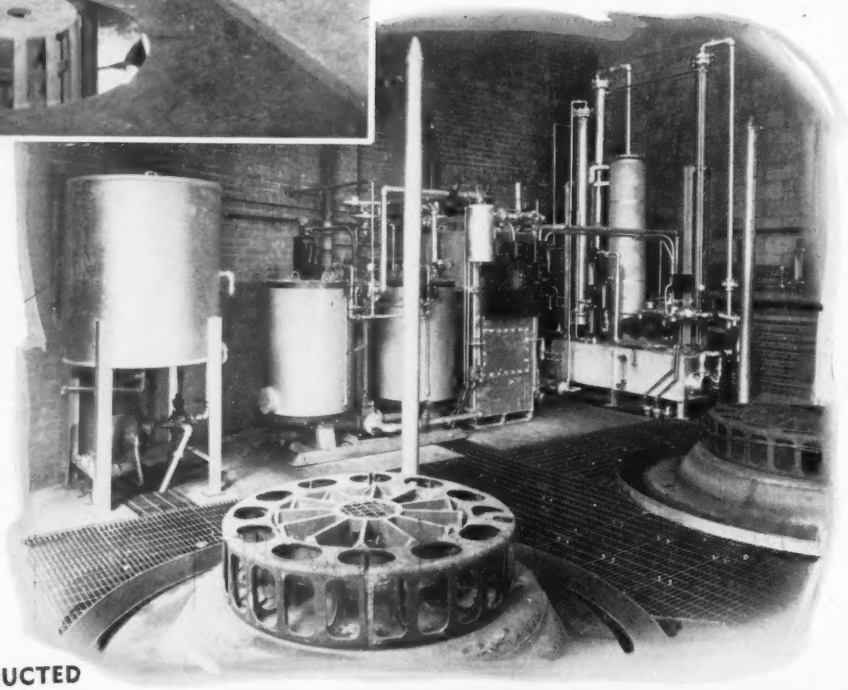
The Lamson & Sessions Co.

HAS NOW COMPLETED ITS FACILITIES FOR *Spheroidizing* ROD AND WIRE COILS



NEW ANNEALING WING

THESE two Wilson cylindrical bell type furnaces and 6 bases provide this Cleveland plant of Lamson & Sessions with means of obtaining any required physical or metallurgical specification for cold heading rod or wire coils and to process the material without decarburizing.



DRY NITROGEN GENERATING EQUIPMENT

ENGINEERED AND CONSTRUCTED BY THE

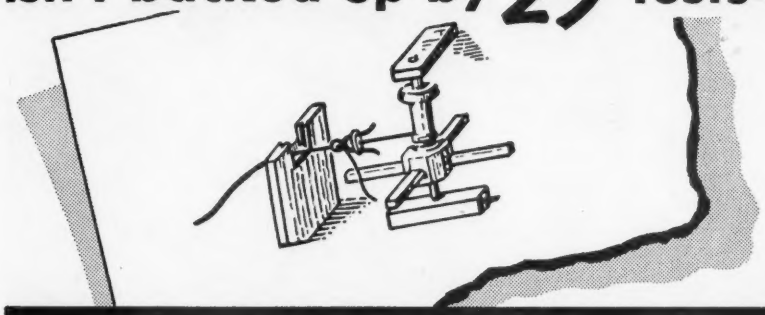
Lee Wilson ENGINEERING Co., Inc.

20005 West Lake Road CLEVELAND, OHIO

Telephone ACademy 4670

INDUSTRIAL FURNACES ★ RADIANT TUBE HEATING ★ HEAT TREATING PROCESSES

This die plate isn't backed up by 29 tests—



BUT THESE DIES ARE!

The die plate on this sixteenth-century wire-drawing contrivance *wasn't* backed by twenty-nine tests—quality-insurance—

But your dies of Carboloy Cemented Carbide are!

Every year Carboloy spends thousands of dollars on testing and improving the quality of the dies you use. You should see all the tests for purity and performance they have to pass!

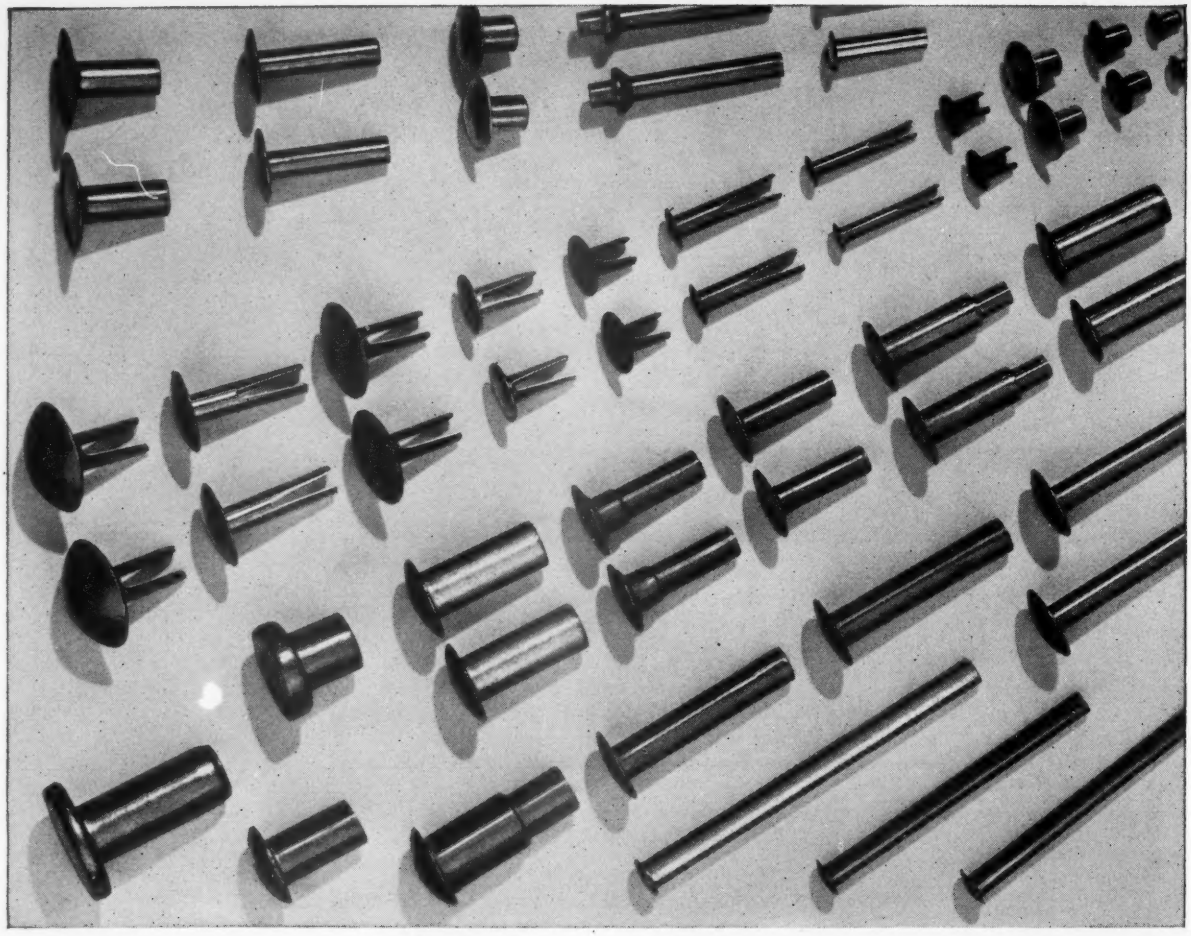
This is just one of the twenty-nine tests, from powder to finished product, that Carboloy Cemented Carbide dies undergo before final release. It is a photo-micrographic examination for checking the micro-structure of the cemented carbide, which must meet Carboloy's exacting specifications.

That's why you can be so sure of quality performance from Carboloy wire-, tube- and bar-drawing products. Let us tell you more about these dies—and about Carboloy's extra benefits and assurances of quality. And ask for the Carboloy DIE SERVICE MANUAL D-119, best of its kind.

CARBOLOY COMPANY, INC., 11171 E. 8 MILE AVE., DETROIT 32, MICHIGAN

CARBOLOY®

CEMENTED CARBIDE



Getting results on cold-heading?

If not, look to the quality of your cold-heading wire. Probably it's a good grade of steel, but may not be the best for the job you're doing.

It pays to be fussy about your needs in cold-heading wire, for the job is half licked when you start with the right steel.

Bethlehem can help in many ways to improve your production of cold-headed items. At your invitation we'll study your products, your equipment . . . and recommend the kind of steel that will perform best. Making the steel for your wire and processing it will then be regulated to meet your requirements, however exacting they may be.

This means close control of such factors as tensile and mechanical properties, grain structure, chemical composition . . . heat-treatment, if required . . . and other considerations that determine how we'll process your steel in our modern wire mills.

Bethlehem cold-heading-quality wire is made to rigid standards. It's sound . . . uniform in analysis, free from injurious surface defects. Thorough inspection at every stage of production is but one phase of the quality-control that's behind every ton we ship.

Whatever your cold-heading job may be, we invite you to consult us. There's no obligation. Just phone your nearest Bethlehem sales office or drop us a line at Bethlehem, Pa.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

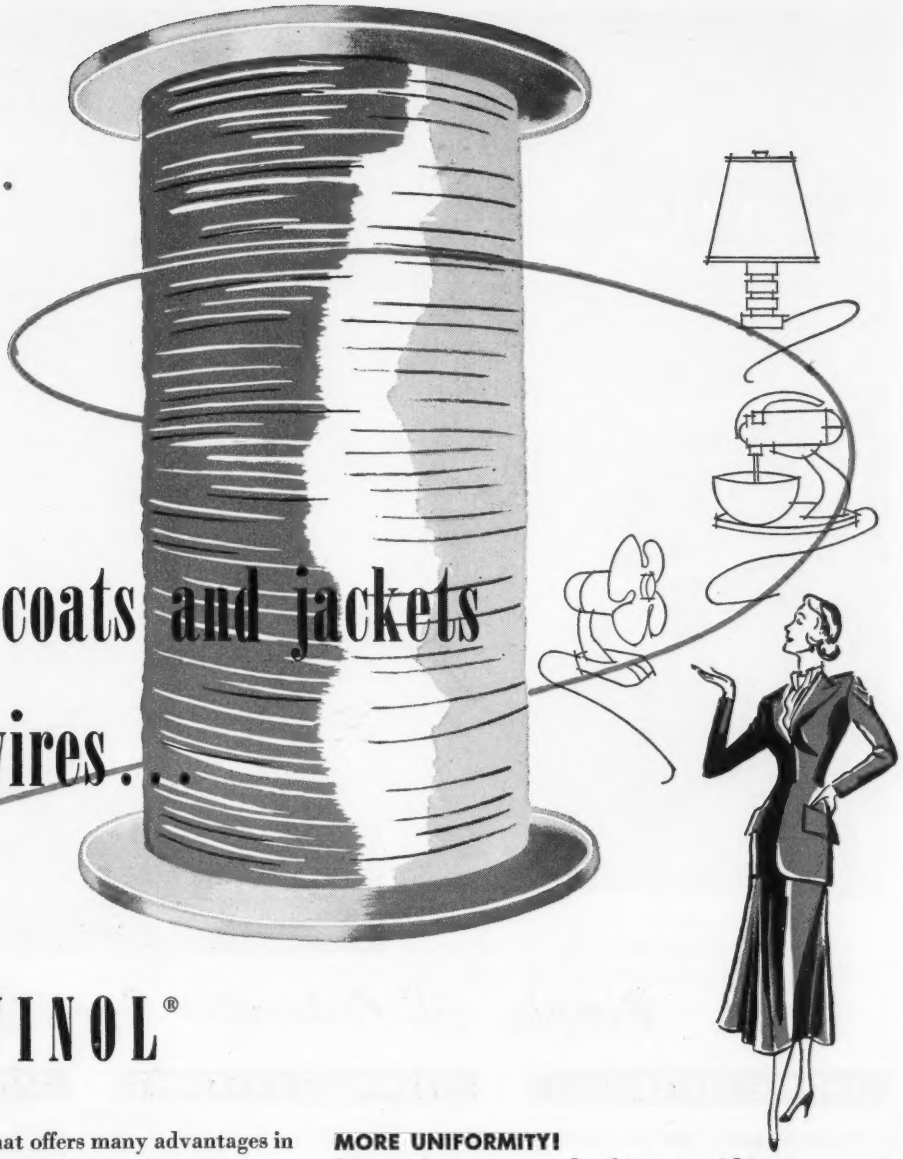
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

Export distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM COLD-HEADING WIRE

WIRE & WIRE PRODUCTS, Vol. 32, No. 6, June, 1948. Publication Office, at 61 Cliff Street, New York 7, N. Y. Executive Office, 300 Main Street, Stamford, Conn. Published monthly by the Quinn-Brown Corp., Richard E. Brown, President; R. S. Spengel, Secy. and Treas. Subscription price: U. S., $5.00; Canada, $5.00 per year; 50 cents per copy; Foreign, $7.50 per year. Entered as second class matter, June 14, 1946, at the Post Office, New York, N. Y., under Act of March 3, 1879.



Better coats and jackets for live wires... with MARVINOL®

Here's a new vinyl resin that offers many advantages in coating or jackets for wiring. For example:

MORE STABILITY! Marvinol offers superior stability in processing and in end products. High molecular weight gives it extra toughness and "dryness" . . . yet it is easy to formulate by extruding, injection molding or other processes . . . is among the most versatile of vinyl resins. Wire covering made from Marvinol has greater resistance to heat and light, greater low temperature flexibility, may be brilliantly or delicately colored, has less heat deformation. Marvinol "coats and jackets" are also highly resistant to oils, acids, foods, aging, wear and other normally destructive factors.

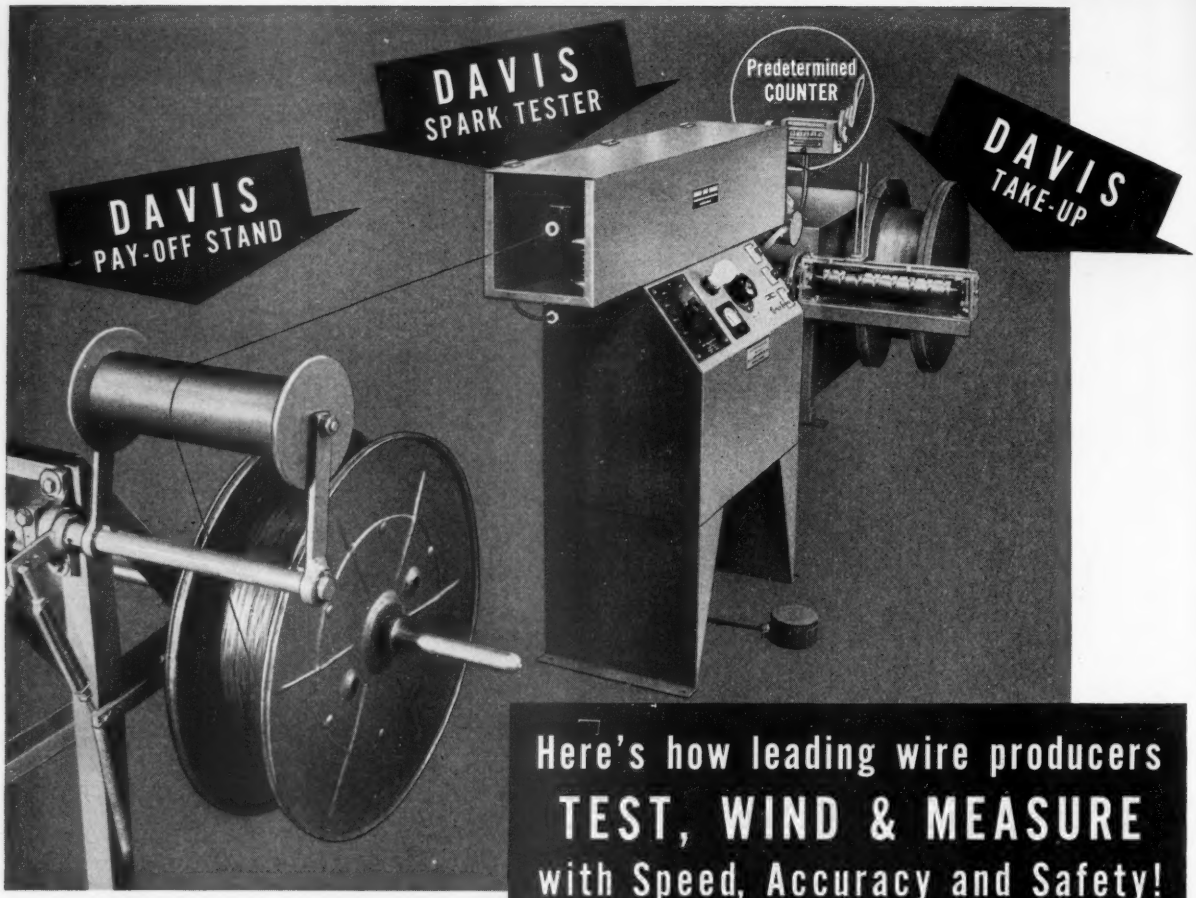
MORE UNIFORMITY! Marvinol resins are a development of Martin research and Martin's quarter-century of plastics experience. They're being produced in the world's most modern chemical plant to assure unexcelled uniformity, and production quantities are now available to processors. The Glenn L. Martin Company, maker of Marvinol, does not compound or fabricate in the plastics field. If you make or coat wire, our sales engineers and customer service laboratory offer full technical cooperation. If you buy or use finished wire, ask your supplier about Marvinol. Chemicals Division, The Glenn L. Martin Company, Baltimore 3, Md.

Martin Marvinol

Resins, Plasticizers and Stabilizers Produced by the Chemicals Division of

THE GLENN L. MARTIN COMPANY—AN INTERNATIONAL INSTITUTION

"Better Products, Greater Progress, Are Made by Martin."



Here's how leading wire producers TEST, WIND & MEASURE with Speed, Accuracy and Safety!

Simple, All-Automatic Operation!

PAY-OFF FEATURES

- Controls tension and braking automatically!
- Prevents over-travel of wire and wire breakage!
- Stops instantaneously when winding spool stops!
- Self-aligning ball bearing pillow block reduces friction!

SPARK TESTER FEATURES

- Detects all dielectric faults!
- Tests wire at any desired voltage!
- Push-button Start & Stop Control!
- Electrically measures predetermined lengths, and stops when pre-set run is completed!
- Automatic torque control for slow starting prevents breaking or stretching of wires!
- Meets Underwriters Laboratories' specifications for spark testing!

TAKE-UP FEATURES

- Worthington All-Speed Drive feeds at 100 to 1500 feet per minute. Other speed ranges available.
- Equipped with automatic brake!
- Stops instantaneously when fault occurs!
- Motor-driven adjustable traverse with width-adjusting stops!

Write us today for detailed information!

DAVIS EQUIPMENT

THE R. L. DAVIS ELECTRIC CO., INC. • WALLINGFORD, CONN.

SPARK TESTERS • SPOOLERS • TAKE-UPS • CAPSTANS

. . . to suit your every need!

Do you make rivets . . . other cold-headed products? Do you need quality copper-alloy wire to be headed, extruded, drilled, or redrawn? Do you need wire of a certain degree of hardness, malleability?

Have you read the headline of this ad? Then you know the answer!

Come to Chase. Chase service, Chase quality . . . is just what you've been looking for. The word quality here means many things . . . freedom from physical defects . . . uniformity of surface texture and color . . . accuracy of dimensions . . . precise adjustment of temper and control of grain size.

Come to the nation's headquarters for brass and copper. Call your nearest Chase Warehouse or Service Office today!

Chase

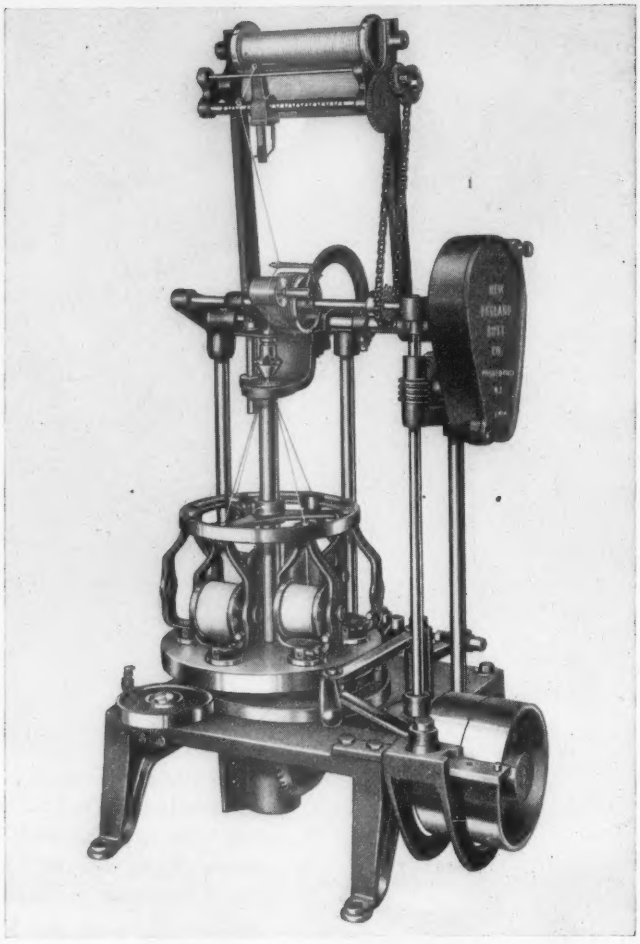
the Nation's Headquarters for
BRASS & COPPER

WATERBURY 91, CONNECTICUT — SUBSIDIARY OF KENNECOTT COPPER CORPORATION

THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

ALBANY† ATLANTA BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DETROIT HOUSTON† INDIANAPOLIS KANSAS CITY, MO. LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† SAN FRANCISCO SEATTLE ST. LOUIS WATERBURY *(†Indicates Sales Office Only)*

SMALL PLANETARY STRANDERS



THE NEW ENGLAND BUTT COMPANY offers small planetary bench type strand-ers for the manufacture of small strand s or cables of either copper or steel.

These machines are built with 6 cradl es for producing up to 7 strands.

Made in two sizes:

C-O Spools — 2-5/8" diameter by 2-3/16" traverse
C-1A Spools — 4" diameter by 3" traverse

Space saving and economical operation obtained with these units.

Write for detailed information.

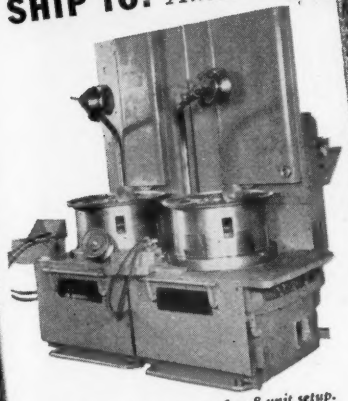
NEW ENGLAND BUTT COMPANY

ESTABLISHED 1842
304 PEARL STREET
PROVIDENCE 7, RHODE ISLAND, U. S. A.

JAMES DAY (MACHINERY) LTD., "FORD HOUSE," 88 REGENT ST., LONDON, W. 1. ENGLAND

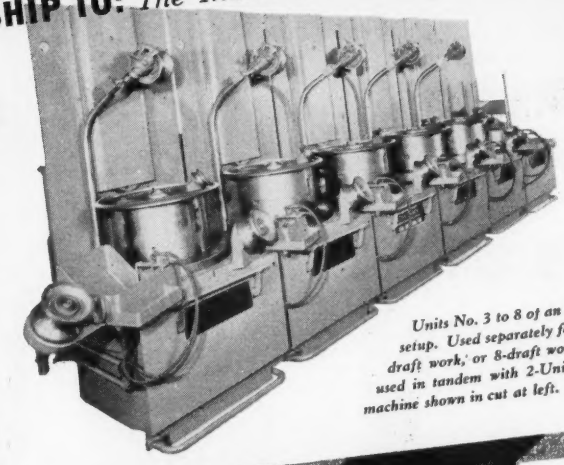
AETNA Wire Drawing UNIT

SHIP TO: *America*

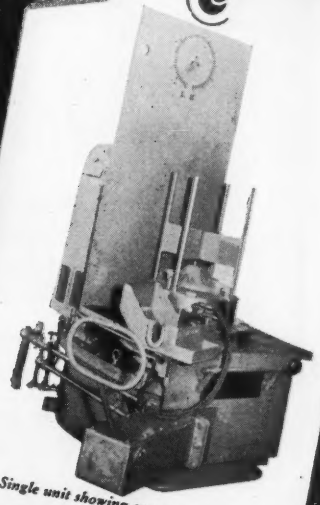


Units No. 1 and No. 2 of an 8-unit setup.

SHIP TO: *The Industry's Growing Demand*



Units No. 3 to 8 of an 8-unit setup. Used separately for 6-draft work, or 8-draft work, used in tandem with 2-Unit machine shown in cut at left.



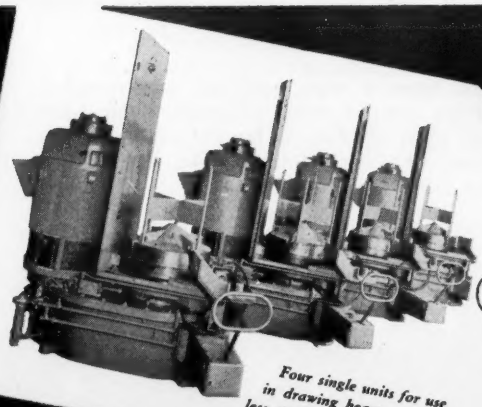
Single unit showing construction and accessibility of parts.

• Labor, time and space are elements of profitable production. You gain these advantages with the *Aetna-Standard Wire Drawing Unit.* Two or more *Units* may be used in tandem with automatic-rheostatic control. The vertical motor on each *Unit* saves floor space and is readily accessible. *Aetna Wire Drawing Units* are available in four sizes (No. 30, No. 22, No. 16, No. 12) for production of heavy, medium and light gauges of carbon steel, alloy steel and non-ferrous wire. Consult us about your wire drawing requirements.

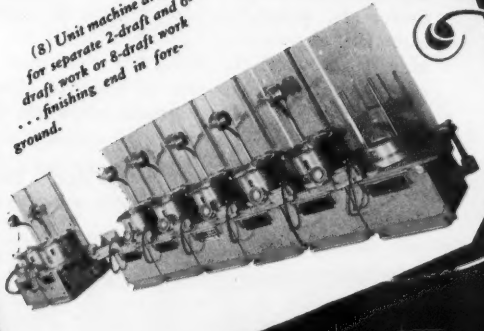
THE AETNA-STANDARD ENGINEERING CO.

YOUNGSTOWN, OHIO

ASSOCIATED COMPANIES: HEAD, WRIGHTSON & COMPANY, LTD., THORNABY-ON-TEES, ENGLAND
AETNA-STANDARD ENGINEERING COMPANY, LTD. . . TORONTO, ONTARIO, CANADA



Four single units for use in drawing heavy stainless steel wire.



(8) Unit machine arranged for separate 2-draft and 6-draft work or 8-draft work . . . finishing end in foreground.

ENAMELED COPPER	TWISTED MULTIPLIES	CELANESE COVERED
ENAMELED IRON	PARALLEL MULTIPLES	GLASS FIBRE COVERED
ENAMELED ALLOY	SILK COVERED	LITZENDRAHT AND
ENAMELED ALUMINUM	COTTON COVERED	SPECIALS TO ORDER

There's more to present day engineering and design problems than shortages of materials, priorities, etc. There is also the question of whether specifications have been rigidly adhered to. Wire, for example, must meet such requirements as specific electrical properties, flexibility, tensile strength, laying speed, uniformity, etc.

Whether it's a buyer's or seller's market, WINCO magnet wire products are drawn to exact specifications. Uniformity of product is guaranteed by mercury process tests and careful supervision guards against variations in consistency, structure or electrical values.

If you have a wire problem, our complete facilities are at your disposal. Send blueprints or specifications for recommendations, without obligation. Samples sent on request: write today.

WINSTED DIVISION

HUDSON WIRE COMPANY

WINSTED CONNECTICUT

Inconel fixtures still in carbo-nitriding service ...after 6,240 hours at 1650° F.

HERE is how one of the world's largest passenger car manufacturers solved a difficult problem in severe carbo-nitride case hardening operations.

The carbo-nitriding furnaces were running on a 24 hour a day, 5 day week schedule. The furnaces —radiant tube fired, muffle gas type—operated at 1650°F. At the end of each 2 hour operating cycle, work and furnace baskets were oil quenched at 120°F.

The problem was to find furnace baskets that could stand up under such destructive service conditions. Corrosion, scale, embrittlement, and mechanical distortion were destroying baskets after as little as 3 or 4 weeks' service.

Baskets made of various metals were tried with little success. Finally, production engineers called for INCONEL.* Result? *One year later, the maintenance report read: "Inconel furnace baskets still in service!"*

Needless to say, this manufacturer, like hundreds of others, has standardized on INCONEL for this service.

If your own production problems demand a metal that will resist scaling and corrosion, and maintain mechanical strength at high temperatures — try INCONEL. This 80 Nickel-14 Chromium alloy is daily proving to be an outstanding metal for heat-treating equipment.

Write for: *"Inco Nickel Alloys for Long Life in Heat Treating Equipment."* Inco's Technical Service will gladly make specific recommendations.

*Reg. U. S. Pat. Off.

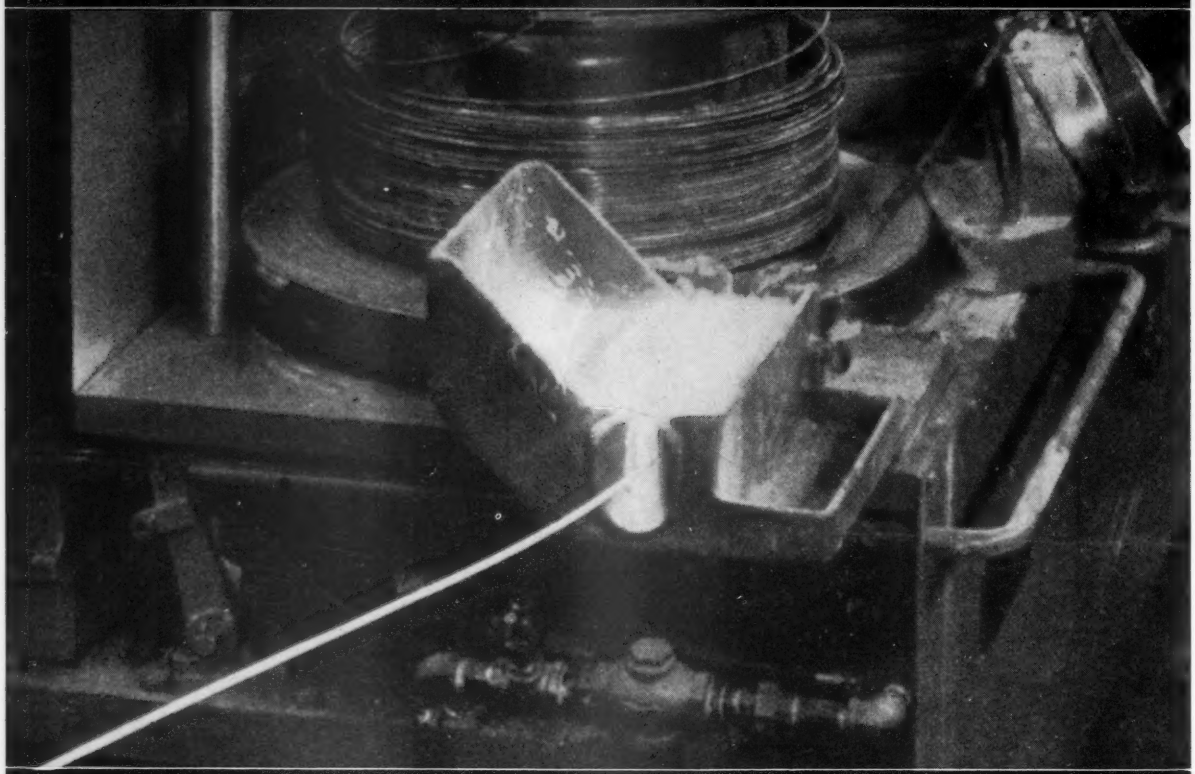
EMBLEM OF SERVICE INCO

THE INTERNATIONAL NICKEL COMPANY, INC. • 67 Wall Street, New York 5, N. Y.

INCONEL —for long life at high temperatures

(80 NICKEL—14 CHROMIUM)

REAL FOLLOW THROUGH . . . NO MATTER HOW HARD THE DRAW!



That's What You Get, Plus Excellent Slip,
When You Use Magnus Dri-Draw Compounds

MAGNUS DRI-DRAW COMPOUNDS were designed to provide effective adherence to the metal, adequate slip and a special ability to follow the metal through the die, no matter how hard the draw.

DRI-DRAW #4 has been unusually successful on difficult draws on low carbon steel, as well as on stainless and high carbon wire. It gives you a very tenacious film of exceptional strength with minimum effect on die life. Finish is very bright – especially on stainless wire.

DRI-DRAW #6 is an all-around compound in extensive use on all dry drawing operations where the special properties of #4 are not required.

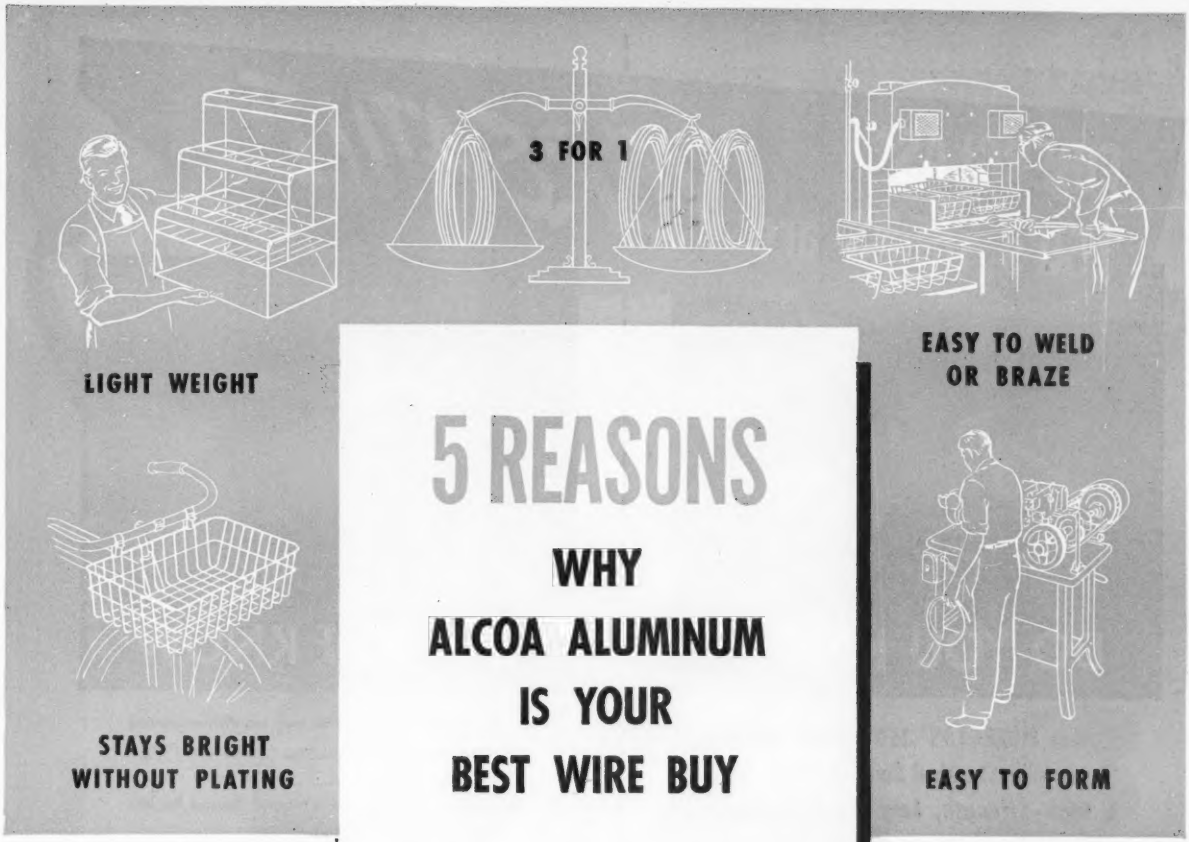
Magnus Dri-Draw Compounds have not only proved their superiority in the draw, but have been and will be consistently maintained at top quality regardless of the raw material situation.

MAGNUS CHEMICAL COMPANY
188 South Ave., Garwood, N. J.
IN CANADA – MAGNUS CHEMICALS, LTD.
4040 Rue Masson, Montreal 36, Que.

IN WIRE DRAWING IT'S
Magnus
CLEANERS • EQUIPMENT • METHODS

Limeless Wire Drawing with Metal Coat #267

Cuts costs . . . insures longer die life . . . gives a better finish . . . causes fewer scratching rejects . . . insures lower lubricating costs. No expense and mess of liming and baking . . . ultimate cost per ton of drawn wire much less than with lime.

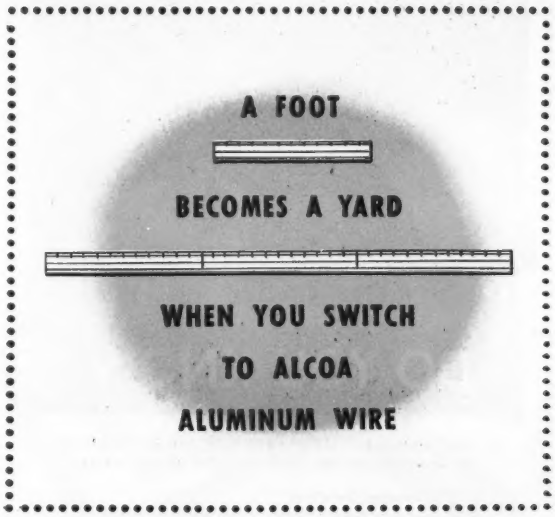


3 times as many feet per pound of wire in aluminum as in copper, brass, or steel. Divide the price of aluminum wire by 3 when you're comparing cost on a parts-per-pound basis. You'll be amazed at your savings in aluminum.

Aluminum wire goods stay bright without paint or plating, will never show red from rust.

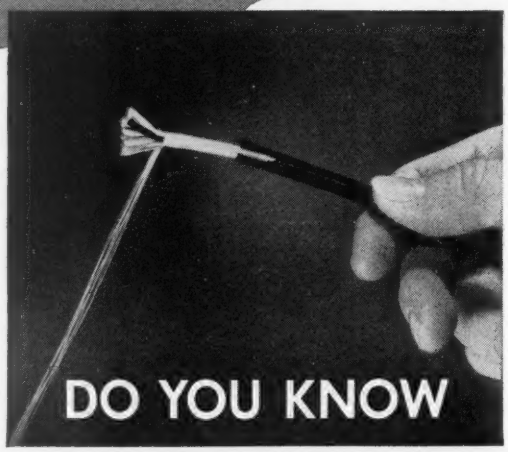
You can form aluminum wire on your present equipment. Braze it or weld it on standard machines to make strong joints.

Customers prefer the lighter weight and lasting beauty of such wire goods as bicycle baskets, guards, grilles, and other products made of Alcoa Aluminum Wire. ALUMINUM COMPANY OF AMERICA, 1828 Gulf Building, Pittsburgh 19, Pennsylvania. Sales offices in 54 leading cities.

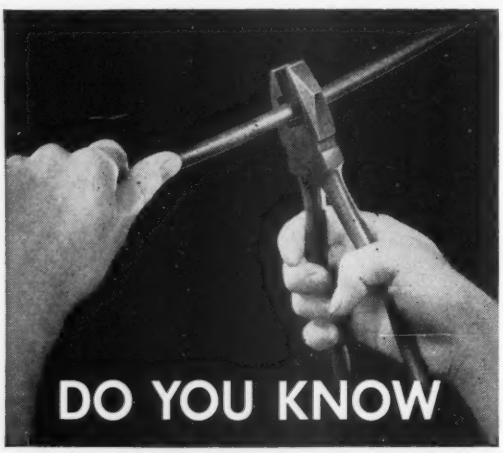


FIBERGLAS* 150's YARNS are VERSATILE

...that FIBERGLAS* 150's Yarns provide Nonmetallic-Sheathed Building Cables with a *High-Strength, Low-Cost Ripcord*?

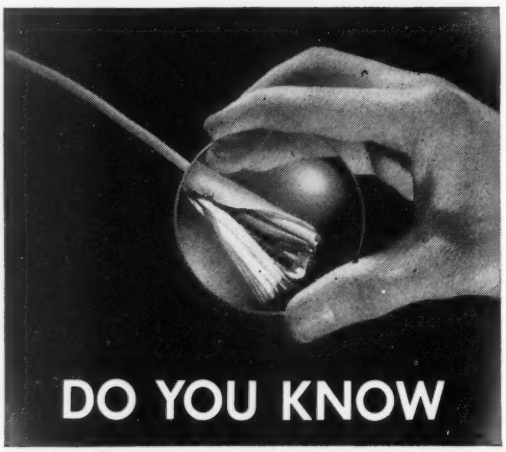


...that braiding or serving costs are lower and efficiency improved *(fewer yarn breaks—fewer package changes)* when you use Fiberglas 150's yarns for separator wraps or braids on flexible cords? In addition, the quality of the cord is improved *(increased flex life)*.



...THAT FIBERGLAS* 150's YARNS USED FOR OUTER BRAIDS OF NONMETALLIC-SHEATHED BUILDING CABLES OFFER:

- Low Material Cost of Braid
- Fewer Yarn Package Changes ... *Less Braider Down Time*
- Fewer Yarn Breaks ... *Improved Braiding Efficiency*
- Lower Cable Shipping Costs ... *Lighter Weight*



... WHY FIBERGLAS* 150's YARNS ARE BEING USED FOR CABLE TENSION MEMBERS?

Answer: They provide low cost ...per unit length of yarn ...per pound of tensile strength with minimum space occupancy

● For complete information about Fiberglas Yarns for these, and other electrical uses, write Owens-Corning Fiberglas Corporation, Dept. 875, Toledo 1, Ohio. Branches in principal cities.
In Canada: Fiberglas Canada Ltd., Toronto 1, Ontario.

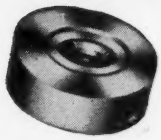
OWENS-CORNING FIBERGLAS Yarns

TM. REG. U.S. PAT. OFF.

***Fiberglas is the trade-mark (Reg. U. S. Pat. Off.) for a variety of products made of or with glass fibers by Owens-Corning Fiberglas Corporation.**

Talide (TUNGSTEN CARBIDE) Drawing Dies

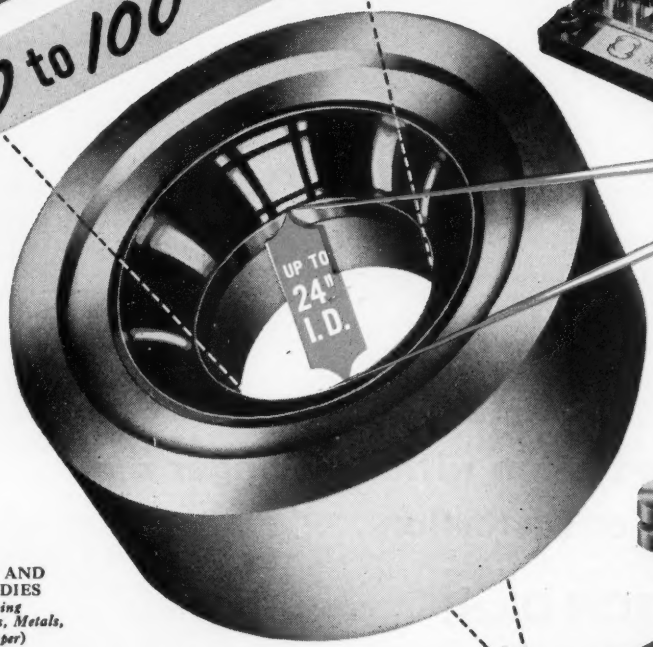
20 to 100 Times the Life of Steel Dies

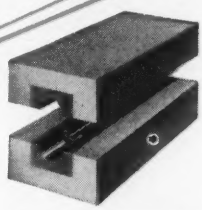


DRAWING DIES
(For Wire, Tubing and Bar Stock)

SPINNING AND CURLING ROLLERS

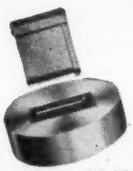
PIERCING AND LAMINATION DIES





SWAGING DIES
(For Forming Solid and Tubular Shapes)

POWDER METALLURGY DIES *(For Compacting Powdered Metals and Materials)*



BLANKING AND FORMING DIES
(For Stamping Lamination Discs, Metals, Plastics, Paper)

Isn't low unit cost your ultimate objective? You get more speed and output on long production runs and at lower maintenance cost with the superior quality of Talide Dies. Talide Dies out-perform and out-wear steel dies 20 to 100 times. Talide (the hardest metal made) saves up to 50 hours polishing and redressing time on a single die. And, since Talide Metal takes and imparts the smoothest finish possible, surface defects are practically eliminated. Purchase Talide (tungsten carbide) Dies in any practical shape and of inside diameter up to 24".

Write for Die and Wear Part Catalog 46-WP.

Talide (TUNGSTEN CARBIDE) Performance!

TUBE MANDRELS

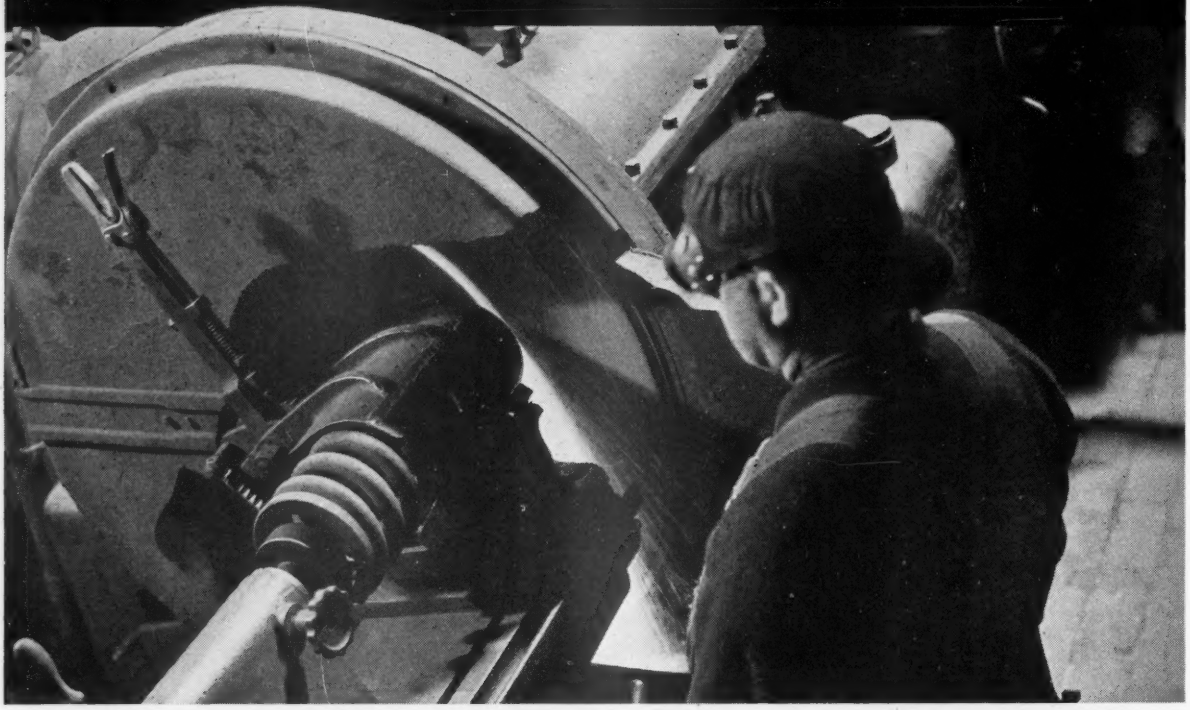
HEADING AND EXTRUSION DIES
(For Shaping and Sizing Bolts, Nuts, Screws, and Collapsible Tubes)

TALIDE METAL MEETS EVERY REQUIREMENT

SINTERED CARBIDES
METAL CARBIDES CORPORATION
TALIDE
YOUNGSTOWN, OHIO
HOT PRESSED CARBIDES

METAL CARBIDES CORPORATION
YOUNGSTOWN 5, OHIO *Pioneers in Tungsten Carbide Metallurgy*
CUTTING TOOLS · DRAWING DIES · WEAR RESISTANT PARTS

Grinding Heavy Springs?



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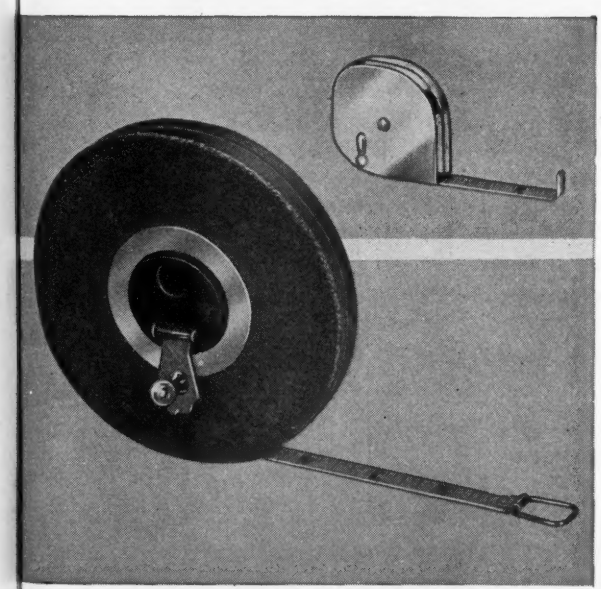

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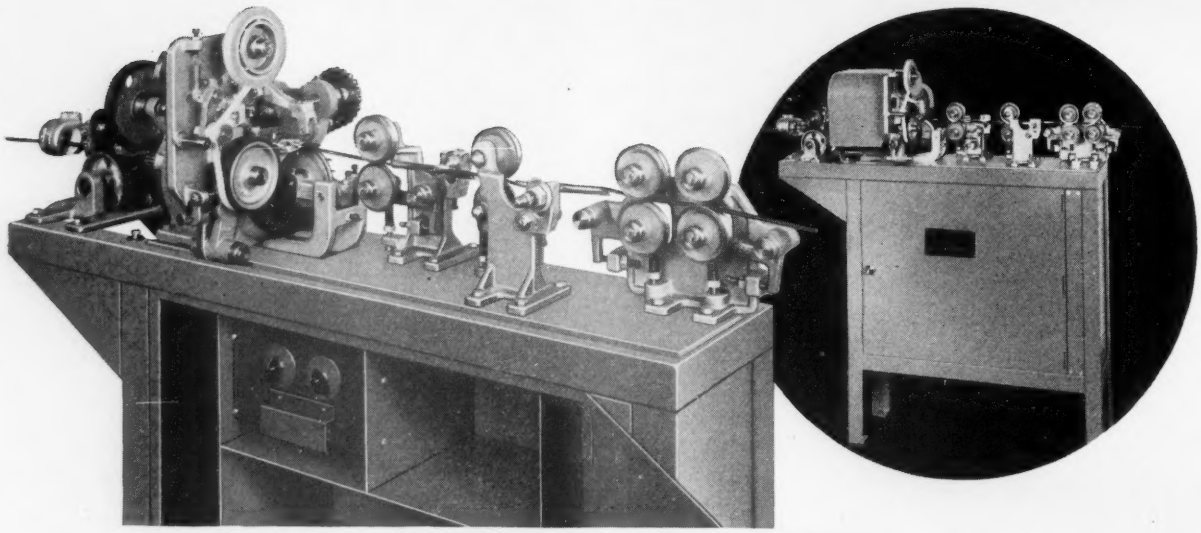

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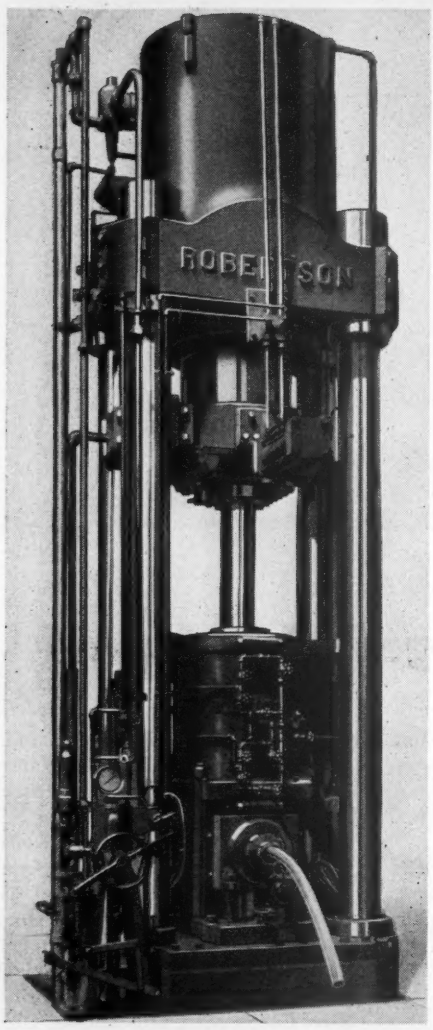

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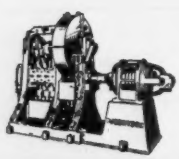

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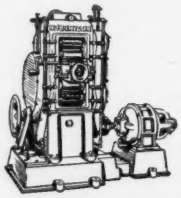

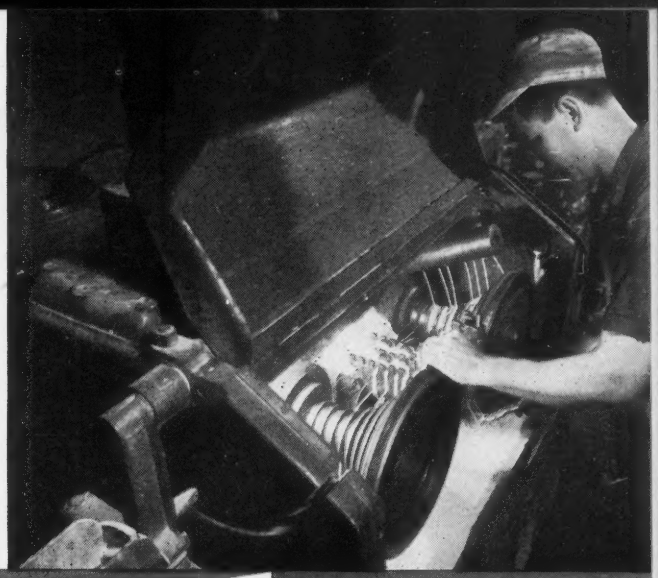

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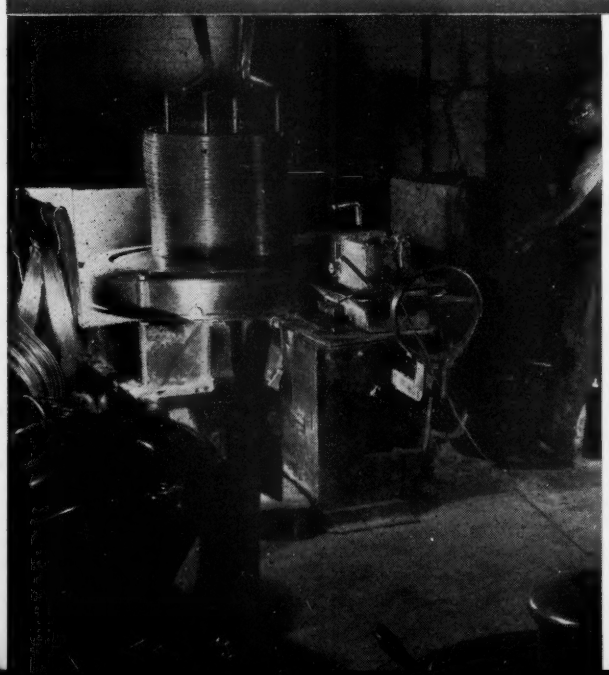

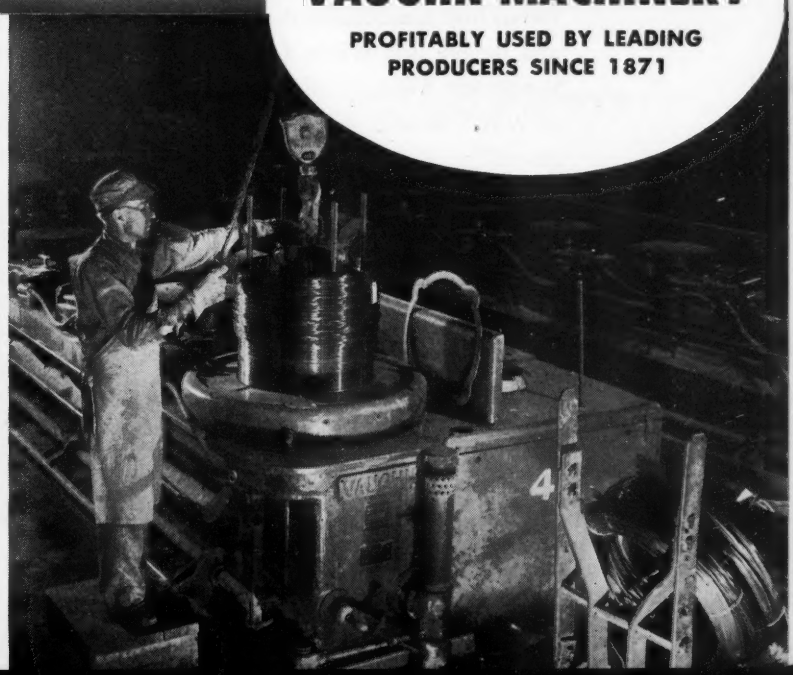

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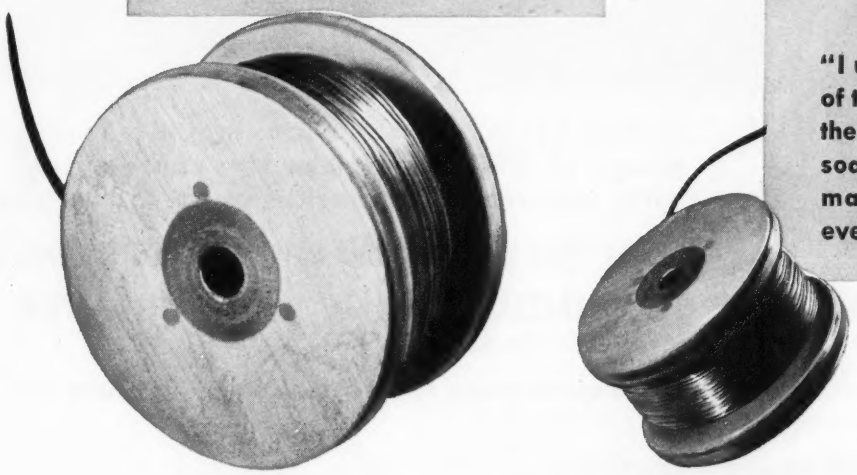

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The Wire Outlook

Concurrent with the resumption of coal production late in April, most of the down steel plants re-started promptly. However, the loss of one and a half million tons of steel, about 2% of our annual output, is a matter of serious concern, as this amount is enough to throw the whole delicately balanced steel distribution set-up out of gear.

Industrial production, within the limits of raw material supplies, is proceeding at a high rate, and is expected by Fall to reach to 100% above the 1935-1939 average. Defense, tax cuts and foreign aid will tend to set new highs in business activity, in spite of the fact that we are assured that ERP exports will not exceed those of 1947. About 5% of our steel will be shipped to foreign countries.

Barring serious developments in the international situation and a wave of strikes or slow-downs, business for the balance of the year should be good.

The price reductions instituted in the steel industry are resented by the union leaders, who, feeling rebuffed, have passed the word around to continue the fight for higher wages.

It is interesting to note that the price cuts made by U. S. Steel as of May 1st were aimed primarily at cost-of-living items — nails, barbed wire, wire netting, fencing, upholstery springs and other wire products, together with steel forms that are to be converted into products to be sold to householders. The reductions will cost this one company $25,000,000 a year on the products affected. This amount is about double the anticipated additional revenue from the price increases on semi-finished steel put into effect in February. Although record earnings in dollars were announced for the industry in 1947, as a percentage of sales, the return was smaller than in 1940 or 1941, or even in the boom year of 1929 — an average for the industry of 6.3%. Hence, the price cuts are a major and salutary effort to check another inflationary spiral.

Electric wire and cable concerns are faced with a sales dilemma. There is a huge potential market, production is high, but shortages of one thing or another have slowed down both private and electric utility building projects to such an extent that warehouses are bulging with finished products. The metal that the electric wire and cable producers are finding hard to secure deliveries on now is aluminum. Copper is readily available. The only other major wire product in balance with delivery is wire rope. Steel wool producers are beginning to cut into their backlogs. Bed spring wire buying has been slower, but all that can be made is readily disposed of. Wire and rods for screws and bolts continue tight and below demand. The automotive industry has eased its pressure for spring wire due to a combination of their own production setbacks and better balanced inventories.

Output of merchant and manufacturers' wire has shown a small improvement, as has the supply of spring wire. There has been little change, however, in the overall picture of wire supply. The curtailment of rod production during the coal strike will be felt later.

Substantial improvement in scrap inventories were reported as a result of the coal strike period. If metal working operations are curtailed because of shortages, scrap will not be flowing back to the mills in normal quantities. Hence, continuing efforts to collect, sort and ship scrap on the part of fabricators is of great importance.

What happens on the labor front in the next few months will bear close watching. Should C.I.O and A.F.L. labor leadership prove as arbitrary, selfish and unenlightened in their efforts to force wage issues at this juncture as was John L. Lewis, we may face serious consequences. What labor would do well to realize is, that its bread is spread with the same butter as capital's.

—from the Editor's Desk

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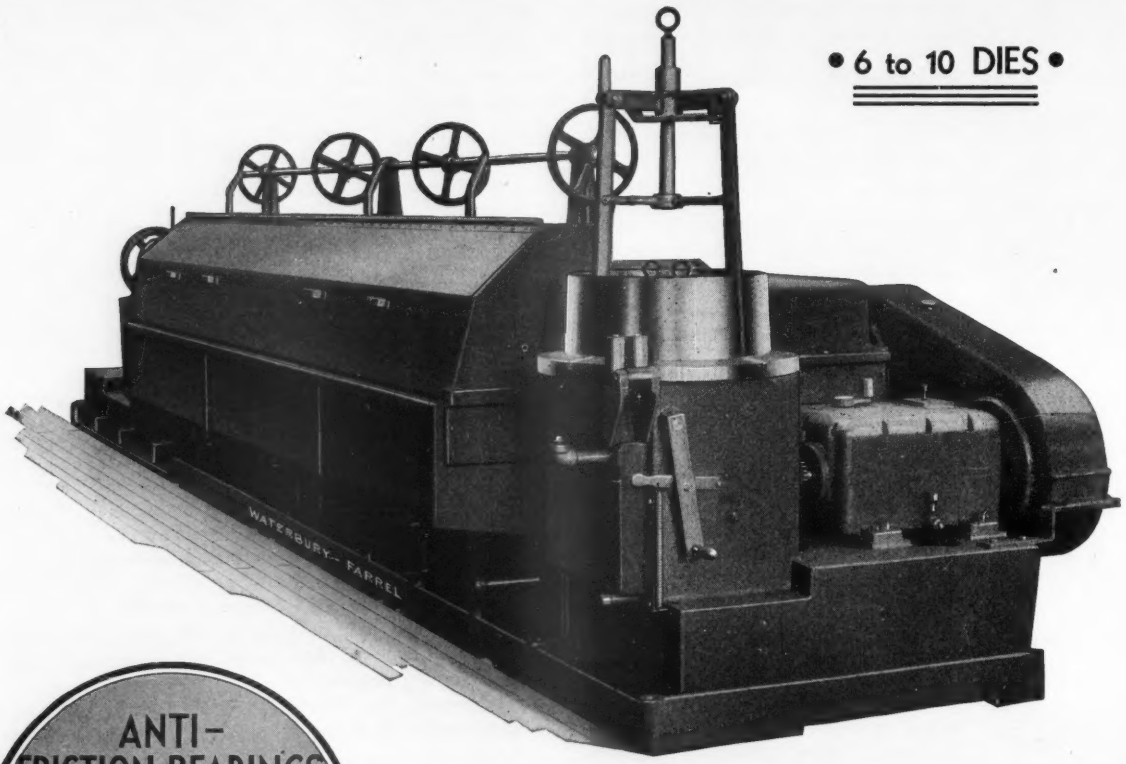

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A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.
DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 23 JUNE, 1948 No. 6

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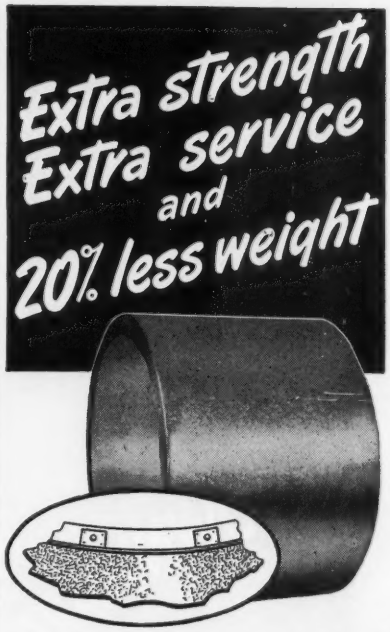

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WIRE
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A monthly publication devoted to the production of Wire, Rod and Strip.
DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 23 JUNE, 1948 No. 6

The Relationship Between Coldworking and Hydrogen Embrittlement

By C. A. Zapffe and M. E. Haslem
Consulting Metallurgist Research Chemist
Baltimore, Md.

INTRODUCTION

In this Journal, a previous article[1] explained the fundamental nature of hydrogen in steel; and a subsequent article[2] described a specially devised bend test applied to a preliminary study of hydrogen embrittlement in steel wire.

Since then, some observations have been made on the effect of coldworking which are interesting from both practical and theoretical standpoints. They are discussed briefly here.

Experimental Procedure

IN Table I there is described the Type 440-C stainless steel used in the experiments. This wire was selected because its typical sensitivity to hydrogen embrittlement allows excellent registration of the effects of any variable affecting hydrogen absorption. Also, the results of the tests can be applied directly to specific plant problems with this grade of steel.

* * *

SINCE we are about to concern ourselves with a variable **within** the steel — coldwork — it is important to keep external factors constant, specifically those which establish the surface concentration of hydrogen on the metal and thereby to some extent control hydrogen absorption. To this end, cathodic pickling is ideal, of course; and all experiments were conducted at a fixed current density of 1.0 amps./in.^{2} in 10% c.p. NaOH solution at specified temperatures.

* * *

AS for the method of testing, reference should be made to previous papers[2,3]. Briefly, a 1/16-in. ø wire is carefully cleaned, hydrogenized, and tested immediately in a single-bend constant-rate machine which bends the wire around a 1/16-in. radius at 5 degrees of arc per second. Duplicate samples are treated; and they are tested exactly 30″ and 90″, respectively, after hydrogenizing. On graphs, the large circles represent the 30″ specimen; the small circle, the 90″ duplicate.

* * *

Some Observations on Mill Handling of Wire Coils

FROM Table I, Specimens I and IIa hereafter will be identified as "laboratory anneal" and "mill anneal" specimens, respectively. The "laboratory anneal" was conducted in an argon atmosphere in the laboratory, securing Brinell hardness values of only 180. The "mill anneal" was performed by the mill in actual plant practice, and reduced the Brinell hardness only to 230.

TABLE I

Description of Specimens
Stainless Steel I.S.I. Type 440-C
Anal: Cr = 17.08%
C = 1.08%
Mo = 0.52%

Specimen	Heat Treatment	Coldwork (% Red Area)	Ultimate	Hardness (Brinell)
I	Special laboratory anneal from 1650° F in argon	—	(102,000)	180
II	Mill anneal, slow cool from 1550° F	29.0	104,000	240
IIa	" " " "	—	—	230

*From work performed in the laboratory of the senior author in conjunction with an Office of Naval Research contract on basic studies of gas-metal systems.

WHILE the harder wire can be expected to break at lesser angles of bend, some especially interesting features developed from the tests. Figure 1 shows the course of the bend values for Specimens I and IIa during progressive cathodic pickling over a period of an hour. The mill-annealed wire gave evidence of embrittlement immediately, the bend angle falling below 180 degrees within the first minute and reaching 100 degrees at the end of two minutes of hydrogenizing. At the end of four minutes' hydrogenizing, by way of contrast, the "laboratory annealed" wire still showed no evidence of embrittlement.

* * *

SECOND, in advanced stages of hydrogenizing, the mill-annealed wire levelled off at a minimum bend value some 40 degrees of arc less than that of the laboratory-annealed material.

* * *

THIRDLY, and most significantly, occasional erratic failures occurred in the mill-handled wire at bend angles of **only 20 and 30 degrees.**

* * *

AS will shortly develop, coldwork makes this already susceptible steel unusually liable to hydrogen embrittlement. Consequently, we have here a demonstration of a coil of wire which will bend 180 degrees around a pin of twice its radius; and yet with the minor coldwork resulting from typical mill handling — not wiredrawing, but just rough handling causing some plastic set in the strands — local portions will break at only 20 or 30 degrees of bend around the same radius within a minute or two of contacting hydrogenizing pickling conditions.

* * *

THIS observation is readily checked by moderately bending an annealed section of the wire in the hands and then comparing its reaction in acid with that of the original wire. It is therefore not surprising that 440-C stainless is a mill problem from the standpoint of coil and die breakage. With more careful handling of the wire, and improved annealing, these troubles should disappear, as demonstrated by the persistent ductility of the specimens fully annealed in argon.

* * *

Effect of Coldwork

IN Figure 2, this severe effect of coldwork on increasing the liability to hydrogen embrittlement is illustrated by comparing Specimens I and II. (See Table I.) Here the upper curve, marked "annealed", refers to the laboratory-annealed

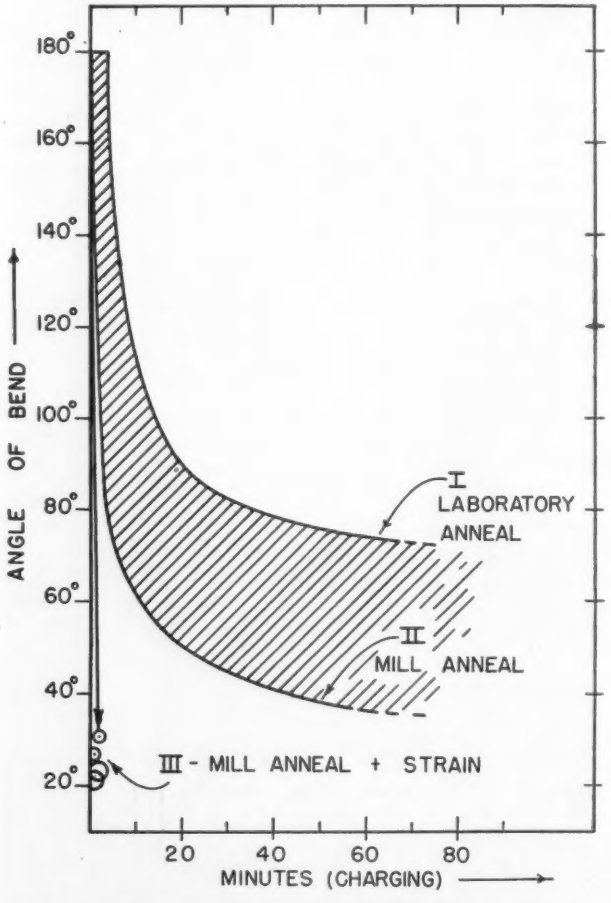

Fig. 1. — Bend angles for 440-C stainless steel wire charged cathodically with hydrogen. The shaded area represents the ductility and resistance to hydrogen embrittlement that can be gained by improved annealing. The cluster of points at the lower left represents the severe susceptibility to embrittlement at locally coldworked areas caused by careless manual handling of the coil in the mill. (Temperature of hydrogenizing: 80°C (177°F)

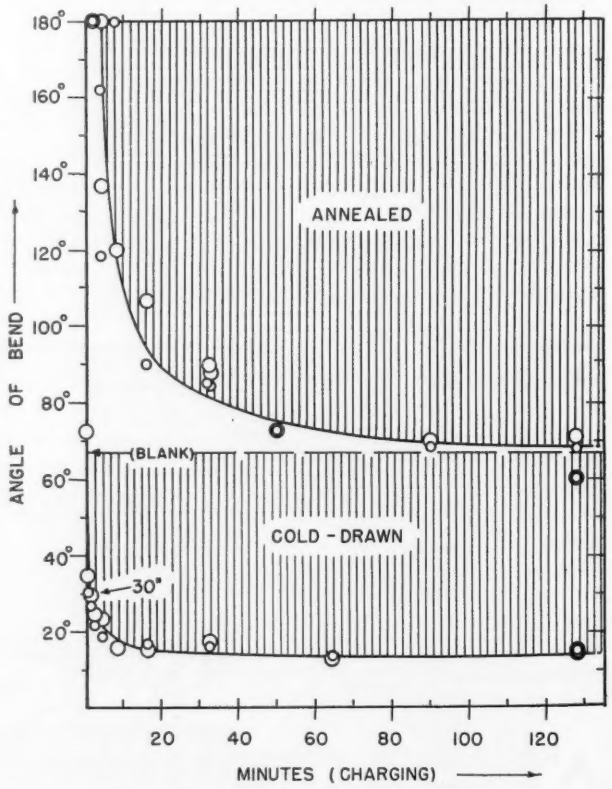

Fig. 2. — Comparison of annealed vs. coldworked Type 440-C stainless wire after hydrogenizing cathodically at 80°C (177°F). While the annealed wire resists embrittlement for over four minutes of hydrogenizing, the coldworked wire shows marked embrittlement in the first 30 seconds. The shaded areas measure the defection from embrittlement, the coldworked wire bending 65 degrees of arc in its original condition. * * *

steel and provides the data for the upper curve in the previous Figure. The lower curve, marked "cold-drawn", refers to the same "mill-annealed" specimens of Figure I, but which have now been cold-drawn 29%.

* * *

THESE results make clear the anomalous cluster of low-angle points in Figure I obtained from carelessly handled annealed wire, for a 30-second hydrogenizing treatment of this uniformly coldworked material immediately reduces the bend angle from its blank near 70 degrees of arc to 30 degrees; and further treatment continues to lower the angle toward **10 degrees** — a virtually glasslike condition.

* * *

BESIDES containing the explanation for Figure 1, the curves in Figure 2 in addition provide important observations regarding the care that should be exercised when permitting this grade of steel to contact hydrogenizing environments, particularly when plastically deformed to any degree whatever. There is a great deal of difference between redrawing, or cold-heading, or even coiling, a material bending 65 degrees around a radius and the same material in the hydrogenized condition bending only 15 degrees without breaking.

* * *

Effect of Temperature

AN interesting effect of temperature is disclosed in Figures 3 and 4. Here the tests of Figure 2 are repeated at 50°C (122°F) and 20°C (68°F); and the embrittlement plainly becomes less severe as the temperature of the test is lowered. Although the coldworked specimens reveal the effect only slightly, it results in the anealed specimens withstanding embrittlement for more than half an hour at 20°C, as contrasted to four minutes at 80°C.

* * *

THESE data are the logical result of a decreased thermal energy at the lower temperatures, which means slower reactions, and specifically a slower infusion of H atoms into the metal lattice. Nevertheless, they are especially pointed out because of a possible confusion with the fact that mild heating is known to drive off the gas and promote recovery. In the case of recovery, however, as will be described in detail in a later article, the mild heating merely expands the occluded **molecular** gas until it finds its way to the surface. This is a different matter from the present consideration of absorption by dissolving **atoms.** One is principally mechanical, the other chemical.

* * *

SECONDLY, the fact that higher temperatures in **straight acid pickling** cause increased embrittlement is not unexpected because of the greatly increased rate of metal attack, hence of hydrogen development; and the opinion is sometimes heard that these conditions obscure a general tendency for recovery at the higher temperatures. Figures 2, 3, and 4, based upon the cathodic conditions of constant hydrogen

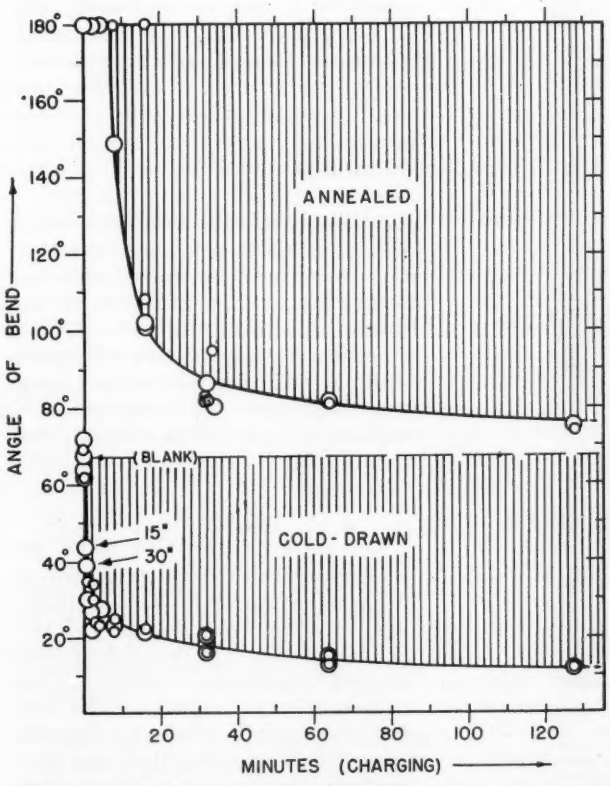

Fig. 3. — Tests of Figure 2 repeated at 50°C (122°F). The annealed wire resists measurable embrittlement for twice as long a hydrogenizing period as at 80°C (177°F). * * * * * *

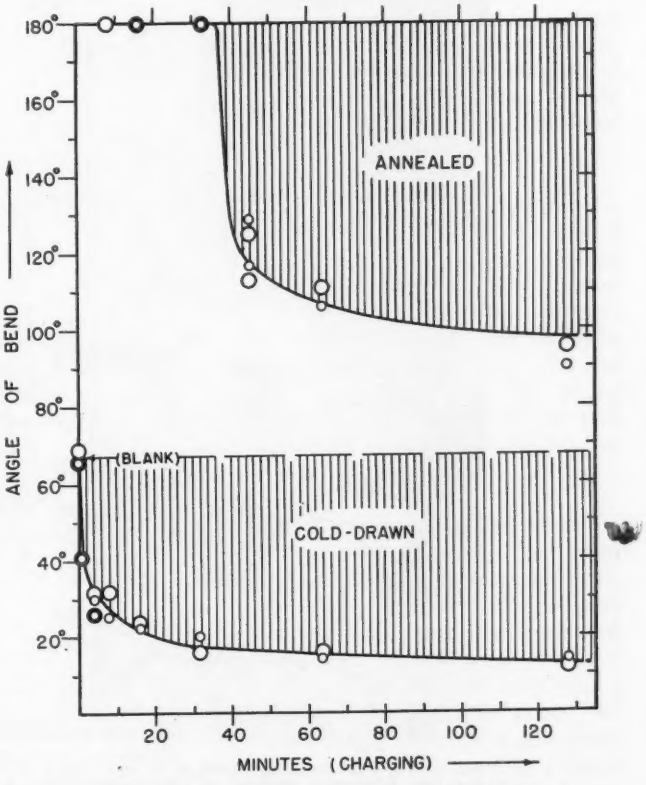

Fig. 4. — Tests of Figures 2 and 3 repeated at 20°C (68°F). The annealed wire now withstands measurable embrittlement for over half an hour; and the coldworked is also somewhat less affected. Also, there appears to be a lower limiting bend value for extended charging times which increases with decreasing temperature. (Compare extent of unshaded areas in Figures 2, 3, and 4.) * * * * * *

concentration prove that the basic tendency is for more rapid absorption and increased embrittlement at higher temperatures, even in the absence of augmented hydrogenizing conditions.

* * *

IN other words, just as higher temperature speeds recovery when the metal is removed from hydrogenizing conditions, so does it speed embrittlement when under hydrogenizing conditions. In addition, there is some evidence in each of the Figures 2, 3, and 4 that a **lower limiting bend value** is approached as a limiting condition of embrittlement for each particular test, and that **at higher temperatures greater embrittlement is attainable.**

* * *

Discussion

MUCH of the argument and previous misunderstanding regarding the relationship of coldwork and hydrogen problems follows from the failure of metallurgists to define clearly the nature of the structure which operates to allow metals to deform without cleavage. The movement within the crystal that takes place during coldwork is technically called "slip". This is a suitable term, for the adjacent sections of the metal truly do slip along the "slip plane". But it is only in a very recent period that recognition is being given the fact that the slip architecture has the properties of looseness, or imperfection, rather than an ideal arrangement of atoms rolling on atoms.

* * *

WITHOUT concerning ourselves with the current metallurgical problem involving the details of the imperfection, or "looseness", we have available in this and the two previous articles[1],[2] sufficient experimental observations to provide a clear understanding of hydrogen embrittlement and its involvement with coldworking.

* * *

FIRST, we recall the ample calculations proving that hydrogen enters the metal as tiny individual H atoms entering the actual interstices among the iron atoms. This has the nature of a true chemical reaction, the dissolving expressing a mild chemical affinity of iron for hydrogen, and the amount of absorption depending directly on the surface concentration of the individual H atoms. The latter relationship accounts for the great absorption during pickling, where H atoms are plentiful, as contrasted to their rarity and the consequent lack of absorption in a commercial hydrogen storage tank.

* * *

NEXT, ample demonstration was given of the tremendous power available to this dissolved gas whenever and wherever it evaporated from the iron lattice against an enclosure; and by means of "fractography" it was demonstrated that a vast microscopic architecture of looseness existed within each and every grain into which this gas could precipitate and collect under pressures even exceeding the strength of the steel.

* * *

NOW, regarding this substructural looseness as being ever present, but more or less developed depending upon the condition of the steel; and recognizing that plastic movement from coldwork will cause shifting and reorganization along these same planes of looseness which contain compressed hydrogen, we can predict and explain all observations.

* * *

FOR example, annealed metal resists embrittlement, as shown in the present research. This logically follows from the necessity of the hydrogen opening the poorly developed "looseness" texture. That it does this is verified by the fact that the metal suddenly expands upon becoming embrittled; and particularly by the unique observation

(*Please turn to page* 527)

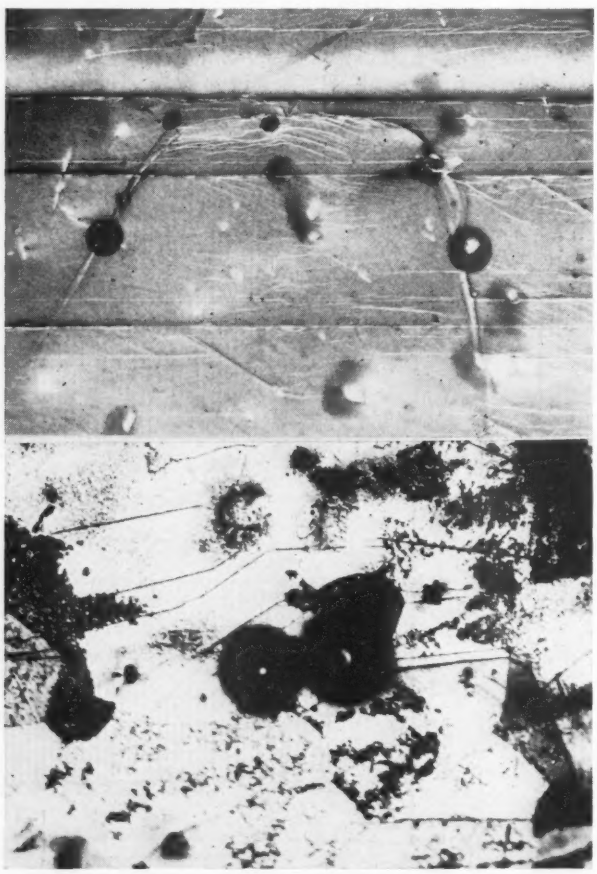

Fig. 5 — Hydrogen bubbles trapped in oil after issuing in sudden spurts from the deformation markings on the fracture surface of iron. The experiment proves that the gas causes embrittlement by occluding under high pressure along the same planes of "looseness" on which the movements of coldwork occur when the metal is deformed. The interrelationships of hydrogen embrittlement and coldwork are thus revealed. (Above) Silicon ferrite. Magnified 200 times. (Below) Armco iron. Magnified 500 times. * * * * *

Spring Design and Manufacture

Part I

By John A. Roberts, Research Engineer
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Redditch, England
(Published in Two Parts)

SPRING action by various methods has been in use from a very early period. Today it is your servant in a thousand different ways, some unnoticed and obscure. It is no exaggeration to say that springs are the life blood of modern civilized life, for without springs the great development which has taken place in engineering and mechanical science would have been impossible.

* * *

THE purpose of a spring is to store energy, to check recoil, diminish concussion, prevent jar and vibration, to aid valve and lever action and to give ease and comfort in car and home, and afford you service in thousands of ways. In fact, it is difficult to imagine a World, mechanical or domestic without the energy, resilience and comfort of the spring.

* * *

SIMPLE every day actions, such as the latching or locking of a door, or turning on an electric light, are controlled by springs. Springs are essential for the working of clocks, watches, gramophones, radio receivers, the intricate mechanism of the automatic telephone, and the gigantic printing presses and weaving looms. Modern travel would be impossible without springs, many thousands of different types being used in bicycles, motor cycles, cars and aircraft.

* * *

IT can thus be realized that the comfort, convenience and even the essentials of our life depend on spring action, and therefore the accuracy, and above all the quality of springs is of the utmost importance.

* * *

THE failure of a spring can, at least, cause inconvenience and at the most, may have serious or even fatal results.

A paper delivered before the Staff School of Frederick Smith & Co. Wire Manufacturer, Ltd., Caledonia Works, Halifax, England, Nov. 1947 in the introductory remarks by the Director, Staff School, Mr. Peter Smith. He said:

"The Ferrous Wire Industry in Great Britain, contains two groups whose interests are respectively Mild Steel and Hard Steel, although some firms are active in both these divisions. We are today concerned with that group which produces High Tensile Wire for a number of purposes of which by far the largest are Rope manufacture and Spring making.

There are not very many Wire Roperies, but their tonnage demand is considerable. The purposes for which wire ropes are made and the processes involved in their manufacture are broadly understood by the wire trade. Springs, on the other hand, are produced by a very large number of manufacturers and the uses to which wire springs are applied appear to be unlimited. Although the High Tensile Steel Wire Industry is dependent for nearly half its output upon its spring wire customers, little is known by us of the principles involved in spring design and manufacture, and the works of reference which exist are very few indeed.

The firm of Herbert Terry & Sons Ltd., are not only the largest of their kind, but have also achieved a world wide recognition for the quality of their products. Mr. J. A. Roberts who is to speak to us today is Research Engineer to Herbert Terry & Sons Ltd., to whose Directors we are indebted for making this Lecture possible.

Mr. Roberts is a leading authority on spring design and manufacture."

WITH the ever increasing demands made on spring performance, a great deal of research is being carried out on spring materials, design and methods.

* * *

IN 1942 the **Coil Spring Federation** was established as a war-time measure to unify the industry for the purpose of meeting the large demands for numerous types of springs vital to the production of reliable weapons.

* * *

THE service conditions under which many springs had to work were abnormally severe in comparison with peace-time uses, and it was essential for the industry, in spite of difficulties affecting raw materials, to ensure that springs capable of the highest possible duty should be supplied and in greatly increased quantities.

* * *

STEPS were taken, in conjunction with the technical branches of Government departments, to initiate investigation covering design, material and methods. This cooperative work was highly successful in its immediate purpose, and also indicated the future benefits to be secured by both manufacturers and users from continued research on the same lines.

* * *

ALTHOUGH individual firms in the spring industry had been active and still are in research work it was clear that common problems could best be solved by coordinated investigation.

* * *

THE **Coil Spring Federation** has accordingly formed a Research Organization which came into operation in October 1945. The scheme which has been adopted for the present provides for extra-mural researches to be carried out by

post-graduate assistants at Universities and represents the first step towards the ultimate object of establishing a central research organization with facilities adequate to maintain the highest possible technical standard.

* * *

THREE researches, respectively on spring steels, the effects of surface protection on the fatigue behaviour of springs, and the relevant properties of cold drawn wire, is in progress at Sheffield, Birmingham and Manchester. The research work is directed by the Research Consultant, **Dr. R. Genders**, and administered as a whole by the Technical Committee of the Research Organization. The Research Organization has received the approval of the Department of Scientific and Industrial Research who have also supported financially the scheme.

* * *

THE vital importance of research if our industries are to retain their pre-eminent position in the technical world is now generally recognized and needs no further emphasis.

* * *

AS mentioned previously, individual firms in the spring industry are conducting their own research work. My own firm, for example, has Laboratories equipped with the usual physical testing machines, Tensile, Torsion, Brinell, Vickers Hardness, Rockwell, etc., together with special machines for the testing of springs in their finished state.

Testing Stress Range of High Duty Helical Springs

A work of especial interest which is running at the moment is the permissible stress ranges of high duty helical springs manufactured from various grades of material with various treatments.

* * *

THE machine we use for this purpose is a special endurance machine which tests eight springs at once, four on each side of the machine. The compression of the springs is obtained by a set of four eccentrics which are adjustable from zero to a one-inch throw. Eight pistons, four each side having rollers on needle bearings are in contact with the eccentrics and on the other end of the pistons, which slide in and out of the main cast body, caps are placed which register with the inside diameter of the springs. The fixed end of the springs are carried on a bar of steel about two inches square which is adjustable on screwed pillars standing horizontally from the main cast body. This bar can be adjusted to give any desired initial stress. Into this bar are placed mushroom like fittings similar to poppet valves with short stems which slide into holes in the bar. Relays are fitted to each spring so that when one spring breaks the machine automatically stops.

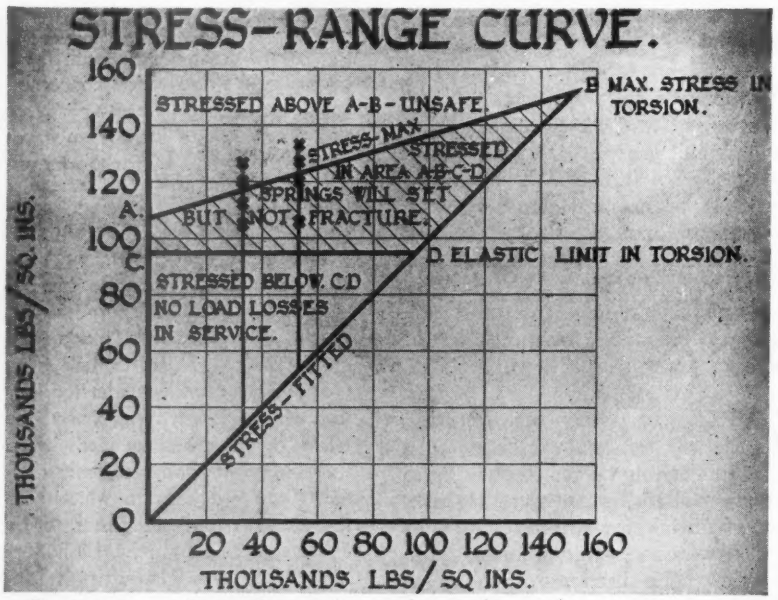

Figure 1.

* * * * * *

THE test procedure is as follows:—

The elastic limit in torsion of the material is tested on an **Avery Torsion Testing Machine** and a graph showing the torsional properties is produced. This information is then transferred to another graph, which gives the initial stress on the x axis and the final stress on the y axis. Springs are then tested for endurance at speeds of approximately 2,000 R.P.M. and run until fracture or to 10,000,000 operation, which is the figure that is considered to indicate that the springs are correctly designed for the particular set of conditions. The results of the tests are then plotted on the graph and when a number of tests have been completed the graph is completed and then it is possible at a glance to ascertain if a certain design of spring will perform satisfactorily and give a long life.

* * *

ANY spring that breaks before 10,000,000 operations, is examined metallurgically to ascertain the cause of the failure. If there is a metallurgical fault the test is considered void and another test with the same set of conditions is carried out.

* * *

WHEN the series of tests are completed, the results are plotted on the graph which indicates:—

(a) The initial stress and the stress range, which results in failure and must not be used in the design of the spring.

(b) The initial stress and stress range which will not cause fracture, but cause slight permanent set in the spring.

(c) The initial stress and stress range, which will not cause fracture or permanent set. (See Figure 1.)

* * *

OBVIOUSLY the springs which come into category (c) are the correct design, although in Valve springs for internal combustion en-

gines, other very important factors arise and I will touch on these later when Valve springs will be discussed.

* * *

IT will be realized immediately that tests of this description are based on a material which is sound and conforms to certain limits laid down in the specification of the material.

* * *

THUS it becomes of paramount importance to institute material control to ensure that the material conforms to specification before it is put into the Stores ready to be manufactured into springs.

* * *

THE tests which are put on to the material vary slightly with the type and grade, but they generally take the following form:—

(1) Analysis.
(2) Tensile Test. One test sample is taken from each end of each coil and is tested against the specification requirements.
(3) Decarburisation. One cross section is mounted from each batch of not more than five coils in a moulded plastic material and suitably polished and etched. Examination is then made at a magnification of 200 diameters and the specimen must comply with the decarburisation clause of the specification.
(4) Test pieces taken from each end of each coil must withstand without sign of failure twisting uniformly the number of turns laid down in the specification and continued to fracture. The sample must give a clean fracture, not open out or show defects.
(5) For small wire sizes samples from each end of such coil shall be wrapped eight complete turns and unwrapped seven turns on a spindle equal in diameter to that of the wire. The sample must not show signs of failure.
(6) Reverse bend test. For larger sizes of wire, samples taken from each end of each coil must withstand without failure, being bent backwards and forwards three times through 180° over a radius equal to three times the diameter of the wire, the first bend of 90° not being counted.
(7) Deep etch test. Samples from each end of each coil shall be immersed in a boiling solution of 50% concentrated hydrochloric acid and 50% water for a period of time equivalent to 2 seconds for every thousandth of an inch diameter. (Minimum time 2 mins.). It is permissible to heat treat the test piece to a temperature between 200 and 375° centrigrade for the purpose of stress relief before carrying out the test. After the test the samples must be free from seams or other defects.
(8) Size tolerance. The wire is checked for size and must conform to the limits laid down in the specification. These tests are characteristic of patented wire.

* * *

WHEN the tests have satisfied the specification requirements the material is put into the material Stores ready to be drawn from for the manufacture of springs.

Spring Design

LET us now consider the general considerations of spring design.

John A. Roberts, Research Engineer Terry & Sons, Ltd., Redditch, England. * * *

Helical Compression Springs

THESE springs subject the material primarily to **torsional stress.** The pressure a spring will produce bears a definite relation to its dimensions, which relation follows certain mathematical laws, thus:—

FIRST: The stiffness varies as the fourth power of the diameter of wire, other conditions being equal. To illustrate this, assume that a spring 2″ mean diameter of ¼″ diameter wire with 10 active coils will compress 1″ with a load of 70 lbs. Then a spring of similar dimensions with ½″ diameter wire will carry 1,120 lbs., when compressed 1″. Instead of being twice as strong with twice the diameter of wire it will be sixteen times as strong: the fourth power of ¼ is .25 x .25 x .25 x .25 equals .0039; and the fourth power of ½ is .5 x .5 x .5 x .5 equals .0625 which is sixteen times the fourth power of ¼.

SECOND: The stiffness also varies as the cube of the mean diameter other conditions being equal. Taking the same spring dimensions as before, a smaller mean diameter will produce a stronger spring or a larger mean diameter will produce a weaker spring in exact proportion of the altered diameter to the cube of 2. Thus a 3″ mean diameter spring, with ¼″ diameter wire and 10 active coils will carry:

$$\frac{2 \times 2 \times 2}{3 \times 3 \times 3} \times 70 = 20.8 \text{ lbs.}$$

If the mean diameter were changed to 1″ the spring would be stiffer as:—

$$\frac{2 \times 2 \times 2}{1 \times 1 \times 1} \times 70 = 560 \text{ lbs.}$$

THIRD: The strength per inch or any other unit of deflection varies inversely as the number of active coils, other conditions being equal. Taking the same dimensioned spring, if the 10 coils be changed to 20, the spring would compress 1″ with 35 lbs. or half the load of the original spring with 10 active coils. It would compress 2″ with the original load of 70 lbs. If the number of active coils be 5, the load at 1″ compression would be 140 lbs., twice the original figure. If, however, they were all the same pitch the three springs would compress completely solid under the same load, as the 5 coil spring would travel only half the distance at double rate, while the 20 coil spring travels twice as far at half the rate per inch.

* * *

THESE laws apply to **Extension springs** except that strength of this type is affected in the first inch of extension by what is called initial tension which gives a variable load to the spring before the coils begin to open. When this initial tension is overcome, any additional load is in accordance with the laws stated and the load deflection graph is linear.

* * *

INITIAL tension is caused by the angle of feed when coiling which causes the wire to twist as it takes up its position in the close coiled spring. This twist imparts an initial stress to the wire and when a load is applied to the spring to cause it to extend this initial stress has to be overcome before the coils will begin to open. This means that the springs will withstand a certain amount of load without any movement at all and this feature is frequently used to great advantage.

* * *

THE amount of initial tension which can be put on an extension spring depends primarily on the

spring index which is the name given to the ratio of wire diameter to mean diameter of coil. The higher this ratio the lower the amount of initial stress and the lower the ratio the higher the initial stress.

* * *

CALCULATION of helical compression and extension springs can be made by simple formulae.

* * *

THE rate per inch deflection in lbs. is obtained by:—

$$\frac{Gd^4}{8ND^3}$$

Where:—

G equals Modulus of rigidity.
d equals diameter of wire.
N equals number of active coils.
D equals mean diameter of coil i. e. from centre of wire to centre of wire.

* * *

FROM this formula one can obtain the dimensions of the spring which will give a desired result in terms of load.

* * *

THE stress imposed on the wire at any given load can be figured from:—

$$\frac{8WD}{\pi d^3}$$

Where:—

W equals load imposed in lbs.
D equals mean diameter of coil.
d equals diameter of wire.

* * *

THIS formula gives the stress on the material in lbs. per square inch.

* * *

THE stress formula mentioned would be accurate if the material were straight but as it is in coiled form the curvature of the wire must be taken into account. This curvature imposes an increased stress on the inside diameter of the spring. A correction factor must, therefore, be introduced to allow for this increased stress.

* * *

A. **M. Wahl** developed a formula for this correction factor which is usually called K.

* * *

K equals four times the index minus 1 divided by four times the index plus 1 added to a constant figure of .615 divided by the index. You will remember that the index is the ratio of diameter of wire to the mean diameter of coil.

* * *

THEREFORE, the total stress including the correction factor for curvature is the stress calculated by the normal stress formula multiplied by the correction factor.

* * *

IT is often necessary to calculate the effect, not only of slowly applied loads, but of those instantly applied and those by bodies having Kinetic energy.

* * *

THE latter problems often become involved because the velocity is not exactly known. However, if one considers that the work i.e. the force times space done on the spring, exactly equals the work done by the spring, the solution becomes simpler.

* * *

FOR example, when a weight is dropped from a given height the deflection calculation resolves itself into a quadratic equation which is quite simple in solution.

* * *

THE discussion, so far, has restricted itself to **helical springs of round wire,** but **square and rectangular** section material is extensively used. This change in cross section involves a different method of calculation. The actual twisting effect on these sections in accordance with Saint Venant must be taken into account and these are resolved into variables depending on the ratio of one side of the section and the other side of the section. These variables can be calculated and the results put into graph form to make for easy reference and the factors so obtained incorporated into the formulae for deflection and stress.

* * *

WHILST on the subject of helical springs, let us spend a little time discussing that very interesting little helical spring — the **valve** spring for internal combustion engines.

Valve Springs

THIS little fellow can be a nightmare to designers owing to the numerous factors affecting it. The duty it has to perform is extremely arduous.

* * *

THE pressure required must first be calculated. This pressure bears a close relationship to the cam design, weight of reciprocating parts, and the engine revolutions.

* * *

WHEN the required pressure has been obtained, one can commence to design the spring. This spring, as you know, is fitted with a certain amount of initial load which holds the valve down on its seat. The cam operation compresses the spring a further given amount, dependent on the cam design. The difference between these two positions constitutes the stress range and this range is very important as mentioned earlier in this talk.

* * *

ANOTHER extremely important point is the natural frequency of the spring. The frequency of a helical spring can be calculated from the formula:

Natural frequency equals 589 times the root of the rate per inch over the weight of the active coils.

* * *

THE reason why the frequency is so important is due to a phenomenon called **"surging".** Let me explain.

* * *

SURGING is a phenomenon which may be visualized as follows:

* * *

STARTING with a spring the coils of which are uniformly spaced, if we compress this spring slowly by pressure applied to its ends, all adjacent coils will approach each other equally, because all are subjected to exactly the same pressure, and all have the same resistance to compression.

* * *

ON the other hand, if the spring is dealt a sudden blow at one end, as by a cam rotating at high speed, then an additional force comes into play — the inertia of the mass of the spring. This force tends to keep each particle of the spring in the position it occupies when the blow struck.

THE coil at the end where the blow occurs is under the influence of the inertia of practically the whole spring, while succeeding coils are subjected to less and less inertia, not only because there is less mass at the back of them, but also because as we approach the stationary end of the spring, each succeeding coil has less actual motion, and therefore, is accelerated less.

* * *

WITH the cam pressing directly on the lowest coil, which is subjected to the resisting inertia force of almost the whole spring, this coil will close up most, and each succeeding coil less. This occurs during the first part of the compression of the spring, while the mass of the spring is being accelerated in the direction of the compression.

* * *

DURING the last part of the compression movement conditions are exactly opposite. The mass of the spring decelerates, the force of inertia is in the same direction as the pressure of the cam, and during this part of the cycle the coil farthest from the cam closes up most.

* * *

IN between there is a point at which there is no acceleration in the rate of compression of the spring and at which, therefore, all coils close uniformly. Since the coils close up most first at one end, and then at the other end of the spring, the final effect is that the centre part of the spring approaches first one and then the other end.

* * *

AS with other vibrating systems, vibration of dangerous amplitude can occur only if there is resonance between vibration inducing impulses and the natural rate of vibration of the spring.

* * *

IN a general way, the force which causes vibration of the spring is the impulse of the cam against the cam follower. This is a periodic force of a frequency equal to the speed of the cam shaft.

* * *

IT is an irregular periodic force of constant periodicity which can be resolved into endless series of harmonics whose frequencies are: 1, 2, 3, 4, 5, 6, etc. times the frequency of the fundamental periodic force.

* * *

IF any of these harmonics come into resonance with spring, **surging** is the result.

* * *

THE stress on the spring is calculated on the assumption that all coils compress equally, so the deflection per coil is equal to the total deflection on the spring divided by the number of active coils. If one coil deflects more than this then it is subjected to abnormal stress and may fail.

* * *

SINCE the frequency of the spring is inversely proportional to the square root of the weight of the active material, it can be raised, and the speeds of synchronism with more of the harmonics of cam acceleration lifted beyond the engine operating range, by increasing the calculated stress on the spring and thus reducing its actual weight.

* * *

THE lowest harmonic which can come into synchronism is generally the most troublesome, because, as a rule the lower harmonics have the highest amplitudes.

* * *

IT may seem paradoxical that by increasing the stress you may increase the lift of a spring, but it must be remembered that it is the calculated stress to which we are referring, and it is not this stress which causes failure but the higher stress induced by surging.

* * *

NOW, you may have seen some valve springs with variable pitches, that is, with coils closer at one end and you may have wondered why this was so. This scheme is intended to combat surging. The winding of the coils at the stationary end of the spring i. e. the end nearest the engine block are made so close that they will be entirely closed up when the valve is fully lifted. Owing to the very small absolute motion of the coils at that end, this can be done without the risk of making the spring noisy in operation, and if the coils near the stationary end cannot exceed their intended motion, spring surge, if not entirely eliminated is at least materially reduced.

* * *

AS mentioned previously, helical compression springs with even pitch of coils produce a load-deflection graph which follows linear law.

* * *

SOMETIMES this feature is not desired and then it is usaul to use either volute springs made in rectangular section material or conical springs made in round section wire. Let us first consider Volute Springs.

AMERICAN IRON AND STEEL INSTITUTE
SHIPMENTS OF STEEL PRODUCTS
ALL GRADES INCLUDING ALLOY AND STAINLESS
(Net Tons)

AIS 10

JANUARY - 1948
Month

Steel Products	Number of companies	Items	Current Month: Net Shipments (Excluding Shipments to Members of the Industry for Conversion into Further Finished Products or For Resale) (Net Tons)	Current Month: Per cent of Total Shipments	Current Month: Shipments to Members of the Industry for Conversion into Further Finished Products or For Resale (Net Tons)	To Date This Year: Net Shipments (Excluding Shipments to Members of the Industry for Conversion into Further Finished Products or For Resale) (Net Tons)	To Date This Year: Per cent of Total Shipments	To Date This Year: Shipments to Members of the Industry for Conversion into Further Finished Products or For Resale (Net Tons)	Whole Year 1947: Net Shipments (Excluding Shipments to Members of the Industry for Conversion into Further Finished Products or For Resale) (Net Tons)	Whole Year 1947: Per cent of Total Shipments	Whole Year 1947: Shipments to Members of the Industry for Conversion into Further Finished Products or For Resale (Net Tons)
Wire rods	19	24	63,247	1.2	28,342				667,282	1.1	331,192
Wire—Drawn	39	25	228,982	4.2	15,400				2,590,963	4.1	181,783
—Nails and staples	17	26	68,954	1.3	1,373				799,436	1.3	8,481
—Barbed and twisted	14	27	22,578	0.4	2				256,991	0.4	128
—Woven wire fence	12	28	34,645	0.6	182				407,295	0.6	3,616
—Bale ties	11	29	10,169	0.2	-				119,917	0.2	-

Corrosion by Molten Materials

Part I

Compiled by F. R. Morral, Metallurgist
American Cyanamid Company
Stamford, Conn.

This article will be published in two parts. Part II will be published in the July Issue of WIRE AND WIRE PRODUCTS. In that issue Tables II and III will be published.

SUBJECT INDEX

Introduction
I. Molten elements — mostly metals.
II. Molten Salts.
III. Molten Salt Mixtures.
References.

Introduction

DATA, qualitative and quantitative, on the corrosion by molten substances of materials used in the construction of containers is meager. The most complete collection is to be found in **Ritter** (1) and this scattered over 250 pages. An attempt is made in this article to assemble the published information.

* * *

CORROSION of metallic containers by molten metals can often be decided by consulting available phase diagrams. Binary diagrams have been compiled by **Hansen** (15); others, by **Janecke** (16). Attack from molten salts or salt mixtures may often be accelerated or decreased (inhibited) by the presence of certain chemicals. A few instances have been noted in the literature, e.g., less than one per cent sodium chlorate reduces corrosion of steel pots by molten sodium hydroxide as much as ninety per cent (7).

* * *

IN the following tabulation of Sections I and II, data is arranged in 4 major columns. The first column lists the name of the molten substance, metal element, or salt, in many instances with its melting point. The second column gives the type of construction material. The third shows the rate of corrosion given in the literature, when available, in either inches per year (IPY), inches penetration per month (IPM), or grams per square meter per day (g./m^2./d.); the fourth column gives the references. In the third column where no numerical data is indicated, advisability of use has been noted. Section III is self-explanatory.

* * *

GENERAL useful references are listed at the end in addition to those mentioned (27, 28 & 29).

I. MOLTEN METALS

Molten Material	Construction Material	Corrosion Rate IPY. g./m^2.d.	Reference
Aluminum 558° C.	Cast Iron	Recommended	1
	Iron	1000-3000 at 750° C.	1
	Chrome Steel (Analysis Unknown)	1000-3000 at 750° C.	1
	V2A steel 18 Cr, 8 Ni, .10C	Strong attack	1
	Cr-V steel	Recommended, little attack	1
	Stainless steel		
	302	attacked >0.420 IPY	5, 30
	316	attacked	5
	430	attacked >0.42 IPY	5, 30
	410	attacked >0.42 IPY	5, 30
	Nickel	Not recommended	3
	Monel	Not recommended	3
	Inconel	Not recommended	3
	37 Ni — 17% Cr	Poor	23
	25 Cr — 12 Ni	Poor	23
	Ceramic materials	Recommended	1

Molten Material	Construction Material	Corrosion Rate IPY	Corrosion Rate g./m²./d.	Reference
	Graphite	Recommended		1
Aluminum Bronze 1050° C.	Chrome Plate	Resistant		24
Aluminum Iron	Stainless steel (18/8)	Recommended		1
	Alunzinc rich firebrick	Recommended		1
Antimony 630°C.	Inconel	Not recommended		3
	Monel	Not recommended		3
	Nickel	Not recommended		3
Bismuth 271°C.	Aluminum (99.5%)	Recommended		1
	Nickel	Not recommended		3
	Monel	Not recommended		3
	Inconel	Not recommended		3
	Platinum	Not recommended		1
Brass ~900° C.	20 Cr, 1 Cu, .30 C	No attack at higher temperature		1
	Chrome plate	Recommended even at higher temperature		1
	Nickel	Not recommended		3
	Monel	Not recommended		3
	Inconel	Not recommended		3
	Carborundum	Recommended		1
	Corundite	Recommended		1
	Zirconium	Recommended		1
Bronze 1000°C.	Iron	Not recommended		1
	Steel	Not recommended		1
	Ceramic materials	Recommended		1
	Graphite	Recommended		1
Cadmium 321° C.	Cast Iron	Recommended		1
	Stainless steel			
	302	Attacked	0.12 — 0.42 IPY	5, 30
	316	Attacked		5
	410		0.12 — 0.42 IPY	30
	430		0.12 — 0.42 IPY	30
	Platinum	Not recommended		1
Calcium 800°C.	Iron	Not recommended		1
Copper 1064° C.	Nickel	Recommended		1
	Nickel chrome	Recommended		1
	Iron	Not recommended		1
	Platinum	Not recommended		1
	Fire Brick	Recommended		1
Lead 327° C.	Aluminum (99.5%)	No attack at 350° C.		1
(Addns. of Pb0 increase attack	Iron	No attack at 600° C.		
	Steel, .51 C, .08 Si, .48 Mn .046 P, .058S		.007 at 600°C.	1
	Cr. steel		.002 at 600° C.	1
	V2A steel, 18 Cr, 8 Ni, .10 C		<24.0 at 600° C.	
			<72.0 at 900° C.	1
	Nickel	Little — strong attack		1, 28
	Monel		24.0 at 260° C.	1
	Inconel	Not recommended		3

Molten Material	Construction Material	Corrosion Rate IPY	Corrosion Rate g./m².d.	Reference
Lead 327° C. (Addns. of Pb0 increase attack	Stainless steel 302	Recommended 0.12 — 0.42 IPY		4, 30
	316	Recommended		4
	410	Recommended 0.12 — 0.42 IPY		4, 30
	430	Recommended 0.12 — 0.42 IPY		4, 30
	18:8 (302)	.00035 — .0034 IPY		18
	18:8, Mo (316)	.00035 — .0034 IPY		18
	430	.00035 — .0034 IPY		18
	60 Ni — 12 Cr	Not recommended		18
	60 Ni, 15 Cr, Fe	2.2 at 600° C.		1
	66 Ni, 20 Cr	Recommended up to 1500° F.		28
	80 Ni, 14-20 Cr, Fe	Recommended		23
	37 Ni — 17 Cr	Recommended		23
	25 Cr — 12 Ni	Recommended		23
	Ceramic materials	Recommended		1
	Quartz	Recommended		1
Magnesium 651° C.	Platinum	Not Recommended		1
Mercury (-38.9° C.)	Nickel @ 700–800° F.	Amalgamation pronounced		28
Nickel 1452° C.	Magnesia brick	Recommended		1
Pt and Pt alloys 1755° C.	Zirconia brick	Recommended		1
Selenium 217° C.	Aluminum	Strong attack at high temperatures		1
	Tantalum	Strong attack at high temperatures		1
	Gold	Recommended		1
	Platinum	Strong attack at higher temperatures		1
Silicon 1420° C.	Aluminum	Attacked		1
	Iron	Diffusion at higher temperatures		
	Tantalum	Little too strong attack		
	Platinum	Not recommended		1
Silver (960.5° C.)	Cast Iron	Not recommended		1
Solder	Nickel	Not recommended		3
	Monel	Not recommended		3
	Inconel	Not recommended		3
Sulfur 112.8° C.	Magnesium	No attack		1
	Cast iron	No attack at 445° C.		1
	Cast iron @ 835° F.	.040 IPY		19
	Cast iron @ 260° F.	.02 IPY		19
	Si cast iron	<24 at 445° C.		1
	Steel	Little attack at 445°C.		1
		At 130° C	at 445° C.	
	18 Cr .1 C, Fe	<2.4	>240	
	14 Cr, Fe	<2.4	>240	
	18 Cr, .1 C, 1.8 Mo, Fe	<2.4	>240	
	17 Cr, .4 C, 1.8 Mo, Fe	<2.4	>240	
	18.9 Cr, 7.3 Ni, 1.33 C, .5 Mn, Fe	<2.4	<72	
	18 Cr, 8 Ni, .06 C. Fe	<2.4	<72	
	18 Cr, 10 Ni, .06 C, Fe	<2.4	<72	
	18 Cr, 8 Ni, .07 C, 1 Mo, Fe	<2.4	<72	

Molten Material	Construction Material	Corrosion Rate IPY	Corrosion Rate g./m².d.	Reference
Sulfur 112.8° C.	18 Cr, 1 Ni, 9 Mn, Fe		<2.4 >240	
	18 Cr, 8.5 Mn, Fe		<2.4 >240	
	Niresist @ 835° F.	.59 IPY		19
	Niresist @ 260° F.	.02 IPY		19
	Copper		~1000 at 400° C.	1
	Cu & 5% Mn alloy		~100 400° C.	
	Cu & 33% Mn alloy		~12 400° C.	
	Brass	Little attack		
	Bronze	Attacked		
	A1 — Bronze	Little attack		
	Chrome plating	Recommended		1
	Nickel	Not recommended		1
	Stainless			
	302 at 500° F.	Not attacked		5
	316 at 500° F.	Not attacked		
	430 at 500° F.	Not attacked		
	302	<0.004 IPY (S dry) .004 — 0.042 IPY (S wet)		
	430	<0.004 IPY (S dry) .004 — .042 IPY (S wet)		
	Monel	Not recommended		1
	Tantalum	Attacked		1
	Zinc	Frequently usable		1
	Lead	Strong attack		1
	Gold	Recommended at 445° C.		1
	Silver	Strong attack at high temperatures		1
	Platinum	Strong attack at high temperatures		1
Tin	Aluminum	Attacked		1
232° C.	Cast iron	Recommended		1
	18 Cr, .1 C, Fe (ferritic) 14 Cr, Fe (hypereutectoid)		<240 at 300° C. >240 600° C. >240 600° C.	1
	18 Cr, 1.8 Mo, .1C 15.7 Cr, 1.03 Mo, .44 C, .29 Mn		<2.4 at 300° C. <24 400° C. >240 600° C.	1
	18.9 Cr, 7.3 Ni, 1.33 C, .5 Mn 18 Cr, 8 Ni, .06 C		<2.4 at 300° C. <24 400° C. >240 600° C.	1
	18 Cr, 10 Ni, .06C 18 Cr, 8 Ni, 1.0 Mo, <.07 C		<2.4 at 300° C. <24 400° C. >240 600° C.	1 1
	18 Cr, 1 Ni, 9 Mn, .16 C ~18 Cr, ~8.5 Mn		<240 at 300° C. >240 600° C. >240 600° C.	1
	Brass	Not recommended, attacked		1
	Chromium plate	Not attacked		1
	Nickel	Not recommended		3
	Inconel	Not recommended		3
	Monel	Not recommended		3
	Stainless steel 302	.042 — 0.120 IPY		30
	302	Less than .00035 YPM		20
	316	Less than .00035 YPM		20
	430	Less than .00035 YPM		20
	430	.042 — 0.120 IPY		30

Molten Material	Construction Material	Corrosion Rate IPY	Corrosion Rate g./m².d.	Reference
Zinc 419°C.	Aluminum	Attacked at higher temperatures		1
	Cast iron		31000 at 500° C.	1
	Cast iron (at 925-950° F)	23.9 IPY		19
	Cast Iron 1" below molten $N4_iC1$ flux at 800° F	12.95 IPY		19
	Cast Iron 2" below molten $N4_iC1$ flux at 800° F	17.95 IPY		19
	Niresist (925-950°) F 1" below molten NiH_i C1 flux at 800° F	2.04 IPY		19
	Niresist 2" below molten NiH_i C1 flux at 800° F	2.30 IPY		19
	Black malleable cast iron (2.25% C, 0.98 Si)	Strong attack at 470° C.		1
	White malleable cast iron (0.25% C)	No appreciable attack at 470° C. in 100 hrs. Recommended		4
	Ferrosilicon		430 at 420° C.	1
	18 Si — Fe 14 Si — Fe	Not usable at 500° C.		1
	.6% C steel		19000 at 500° C.	1
	Chrome plate	Attack at same rate as steel		24
	Wrought Iron		56200 at 500° C.	1
	Iron, pure		11000 at 600° C.	1
	Armco Iron	Recommended for galvanizing pots		
	.35 — .45 C, .5 — .8 Mn, (.8 — .9 Cr) less than .045 P, and .005 S	Recommended for die casting		1
	Stainless steel 302	Over .005 IPM >0.420 IPY		30
	302	Attacked		5, 20
	430	>.420 IPY		30
	410			
	430			
	18.9 Cr, 7.3 Ni, 1.33 C, .5 Mn	Not usable at 500° C.		1
	18 Cr, 8 Ni, .06 C, Fe	Not usable at 500° C.		1
	18 Cr, 10 Ni, .06 C, Fe	Not usable at 500° C.		1
	18 Cr, 8 Ni, 1. Mo, <.07 C, Fe	Not usable at 500° C.		1
	18 Cr, 1 Ni, 9 Mn, .16 C, Fe	Not usable at 500° C.		1
	~18 Cr, ~8.5 Mn, Fe	Not usable at 500° C.		1
	Mo — Fe alloy (>80% Mo)	Recommended		1
	37 Ni — 17% Cr	Poor		23
	25 Cr — 12 Ni	Poor		23
	Chromium electrodeposits	No attack		1
	Nickel	>240		1, 28
	Inconel	Not recommended		3
	Monel	Not recommended		3
	Gold	Strong attack		
	Alumina rich fire brick & 10% coke powder	Recommended for muffles		1
	Iron free fire brick	Recommended for distillation units		1

Molten Material			Reference
Effect of additions to zinc on corrosion of pure iron			1
Zinc 419°C.	% addition	Loss in g/m²/day at temperatures given	
		420° C.	480° C.
	0	6720	9600
	0.01 Al	3530	5420
	0.05	960	2080
	0.1	320	960
	.2	160	400
	.3	80	80

Losses in g/m²/day on Armco iron based on one 1 hr. immersion at

Material	440 °C.	460° C.	480° C.	500° C.	520° C.
Electrolytic zinc	1800	2000	3800	7300	
" & 0.2% Cu		2400	3800	7000	6100
" 1.0% Cd	2200	2600	4300	13000	8000
" 0.2% Al		300	1200	4800	
" 1. Sb	2200	2600	4300	13000	13100*
" 1 Sn	2000	2200	5600	8500*	
" saturated with Pb	1800	2000	4000	9000	*

*(these go over a maximum)

Material	Loss of weight in oz/sq.ft/hr. at			(22)
	860° F	.900° F	930° F	
Technically pure Fe (.02% C)	.72	.90	1.60	
Sheet steel (.06% C)	.79	1.20	1.70	
Sheet steel (.11% C. .30% Cu)	1.20	3.15	6.10	
Puddled iron (.03% C)	4.00	5.90	8.0	
Carbon steel (.6% C)	.95	1.15	2.7	
(.8% C)	1.01	1.27	2.6	
Cr — Cu steel (.2% C 0.6±% Cu, .45% W)	1.7	2.1	3.25	
Si steel (.1% C 1.0% Si)	7.0	9.6	11.2	
Cr steel (6.7% Cr. .09% C)	.6	1.7	1.2	
Cr steel (.65% C, 22.8% Cr)	2.8	—	4.2	
Grey cast iron (3.60% C 2 Si)	2.6	3.5	4.5	

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LABOR RELATIONS

by John B. Stone,
Washington, D. C.

The fourteenth of a series of articles on the subject, with particular reference to problems of the wire and wire products industry.. The author is a noted authority on the subject.

A pattern of wage relationships which may govern American industry for many years to come, if a depression doesn't knock the bottom out of all plans, is being worked out these months to the accompaniment of strike headlines.

* * *

ALTHOUGH the headlines feature the big industries like coal, big steel and the giants of the electrical industry, the results of the "third round" show down will be of utmost importance to small and medium sized manufacturers of wire and wire products.

* * *

SELDOM since the pre-war industrial boom began has industry presented such a "united front" to the demands of labor for substantial wage increases.

* * *

FIRST of the major strikes to get actually under way, the walkout of the Packinghouse Workers, was preceded by a demand for wage increases of nearly 30 cents an hour and an offer of 9 cents an hour. The Chrysler row presented a similar pattern as the first of the "show down" cases in the auto industry.

* * *

THE railroad crisis resulted from the workers' demands for truly significant wage increases where a fact finding board had recommended a smaller increase.

* * *

IN steel the companies offered nothing but cut prices to help drive down the cost of living. Steel faced no strike because Phil Murray, president of both the United Steel Workers of America and the Congress of Industrial Organizations had, the year before, signed a two-year contract with a no strike clause and a specification that wages would be reopened only for discussion.

* * *

DOUBTLESS John L. Lewis will present something "different" from the others, but despite his famed individuality the general pattern of American industry in resistance to wage demands in time of boom has seldom been so unified.

* * *

FACING this almost identical stand of the big industries is a labor movement weakened by division both between the CIO and the AFL and within each of the major federations on political issues.

* * *

THE division goes even further and has entered into a majority of the local unions of the big internationals.

* * *

ON this basis alone, labor leaders and observers here in the national capitol admit privately that even if the disputes reach the major strike stage, labor probably will not win any substantial portion of its demands.

* * *

THIS poses the question of what the locals will do in smaller plants which are not affected by the master contracts negotiated with he big industrialists.

* * *

IN the case of steel, of course, many if not most of the smaller processors are covered by the contract negotiated by big steel. The question of breaking away from that pattern still remains but most leaders of industry here feel that now is not the time for that. At any rate the contracts have another year to run.

* * *

IN electrical equipment plants the problem is different. United Electrical, Radio and Machine Workers doubtless would prefer to keep as many of its members employed in these smaller plants when the show down with General Electric, Westinghouse and Sylvania comes.

* * *

IF offered contracts which give their members a semblance of victory, they doubtless would sign. There are many arguments in favor of keeping such plants in operation during a major strike in the big factories.

* * *

ON the other hand, if the third-round showdown comes to a life and death fight between the big industrialists and unions such as UE, the end result might be a scale of lowered wages, by which the smaller plants would profit also.

* * *

THE question is whether present profits justify such a gamble.

* * *

IN substance the situation seems to boil down to this; with supply having caught up with demand in many lines and with profits at a high level, big industry is ready for the showdown and not too unwilling to smash the power of the unions.

(*Please turn to page* 530)

Worcester Regional Meeting of the Wire Association

THE Worcester Regional Meeting of the Wire Association was held at the Sheraton Hotel, Worcester, Mass. on Friday, April 30th, 1948. This meeting developed a great deal of interesting information and discussion and was very well attended. It was the first gathering at which the new president of the Wire Association, **LeRoy D. Seymour**, Manufacturing Manager of the Wire Division of John A. Roebling's Sons Company has presided. Mr. **Rodman R. Tatnall**, Field Service Metallurgist of the Wickwire-Spencer Division of the Colorado Fuel & Iron Corporation of Buffalo, N.Y., was the very able chairman, who prepared this interesting and informative program. The speakers were, **Brun J. Queern**, Chemical Engineer of the Dorr Company, New York, N. Y., whose paper on "The Treatment of Waste from Wire Manufacturing Plants, with Special Reference to Pickle Liquors" proved most informative; Dr. **Armand DiGiulio**, Consulting Engineer, Upton Electric Furnace Company, Detroit, Mich., whose paper on "Aluminum Coating of Steel Products" also proved of much interest to all present. The papers were followed by lively discussions and a motion picture entitled, "Watts in Glass" was shown through the courtesy of the Owens-Corning Fiberglas Corporation of Toledo, Ohio. Following are our Special Correspondent's comments on this meeting.

* * *

IN the view of the Special Correspondent, the technical papers presented at Worcester were the most timely and interesting ever heard there. They covered the treatment and disposal of acid wastes and the coating of steel with aluminum.

* * *

THE acid waste problem has always been with us. It is probably more acute in Worcester than anywhere on account of the concentration of wire mills in the district. Health authorities, indignant readers, fish and game enthusiasts, and laymen of all grades of innocence bombard us in the daily press. Let us start by admitting at once everything they can prove on us, namely that wire mill waste in the sanitary sewers gums up the disposal works, and in the streams kills the fish and pollutes the landscape. Let us admit also that it is undoubtedly possible to correct the situation to any degree whatever.

* * *

MOST industrial plants take in water, process it, and return it to circulation much the worse for wear as to composition and temperature, and in no condition to please marine fauna and flora. The plants could undoubtedly put back into the streams water as pure or

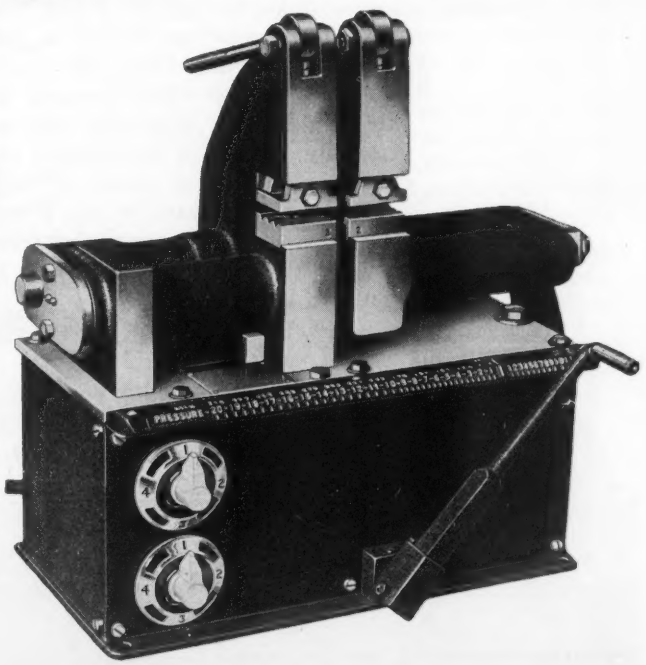
MICROMETER PRECISION — MICRO-WELD — TRADE MARK REG. U. S. PAT OFF.

MODEL T-L MICRO-WELD BUTT WELDER

Welding capacity .080" to .375 diameter STEEL wire

The Model T-L Welder which is a self-contained unit suitable for various types of Butt welding, is equipped with individual hand clamps, and a single control lever for the spacing operation, applying the upset spring tension, and contacting the welding switch.

This unit can be supplied for either bench mounting, overhead crane, or mounted on 4-wheel truck.



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20 NORTH WACKER DRIVE,
CHICAGO 6, ILL.
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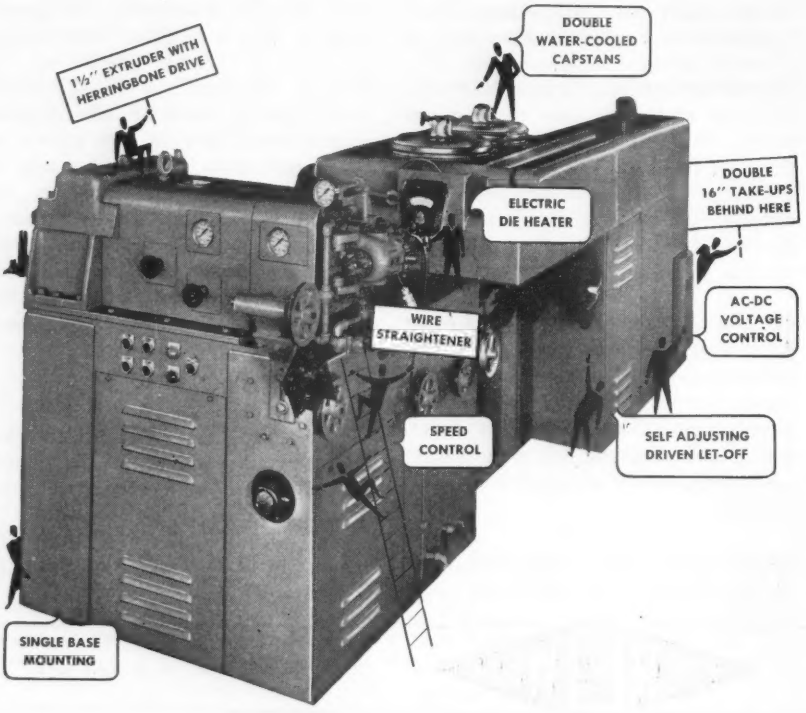
Anyway you look at it...

This 1½" (NRM) Wire Covering Unit Sparkles With Features



SPACE here is too limited to completely describe the unit above. But you can see for yourself... its clean, compact design... only 13 feet long. What you can't see is its versatility... its great performance on smaller diameters of wire at speeds up to 800 feet a minute. If you want to add a great little unit to your wire covering capacity, you'll need more information of course... just drop us a line, today.

NRM

Plastics Machinery Division

NATIONAL RUBBER MACHINERY COMPANY

AKRON 8, OHIO

purer than they took out, but the overall result in cost of product would work a revolution more comprehensive than the one the Communists are preparing. In many cases the treatment would require more space than the primary processes of the plant, and cost as much as the present price of the product. Our way of life is based on the low cost of mass-produced goods, don't let anyone tell you different, and if we stopped to cater to the fish, and to those likeable but slightly off-center characters who delight in pursuing them with rod, reel, and sixty bucks worth of accessories, one of two conditions would ensue; either the fishermen would all be scratching so hard to make a soviet-grade living that they would have no time or energy to fish, or, conversely, leisure resulting from mass unemployment would put more fishers on the banks than fish in the stream.

* * *

STILL, let us admit that the situation calls for something. Our local streams are too filthy to support life even in disease germs, and we are spending two million dollars to replace a sewage disposal system that was, beyond argument, wrecked during the war years by overdoses of pickle liquor. The free acid killed the bacteria that promote the digestion of the sewage and the proper separation of the solids from the clear effluent (I hope I have got the words right,) and the iron hydroxide into which the sulphate broke down proceeded to gum up into a solid mass the carefully graded layers of cracked rock through which the reactions should take place.

* * *

IT is not too difficult to neutralize the free acid in our waste, nor to recover the iron in one of several forms. The trouble is that you spend good money to neutralize, and you can't sell the iron product for what it cost. Any business man rightly regards a money-losing process as a doctor would regard a cancer. Brothers of the Cloister, the Press, and the learned professions, do you realize that it is YOUR money that is thus lost? "Never send to know for whom the bell tolls; it tolls for thee."

MR. Queern, of the Dorr Company, reviewed various methods of handling the problem, all costly and disagreeable. One is to neutralize with lime, agitate until the reactions are complete, settle, draw off a clear water for the stream, and dispose of the remaining goo by smuggling it into a "ravine." Most of us, if we were so lucky as to have one of these convenient ravines, would pump the whole mess direct into it, and let Nature take its course.

* * *

THE mess, a compost of gypsum and iron rust, can be molded and baked into a sort of tile, but we gather that the demand for this tile has not been vehement.

* * *

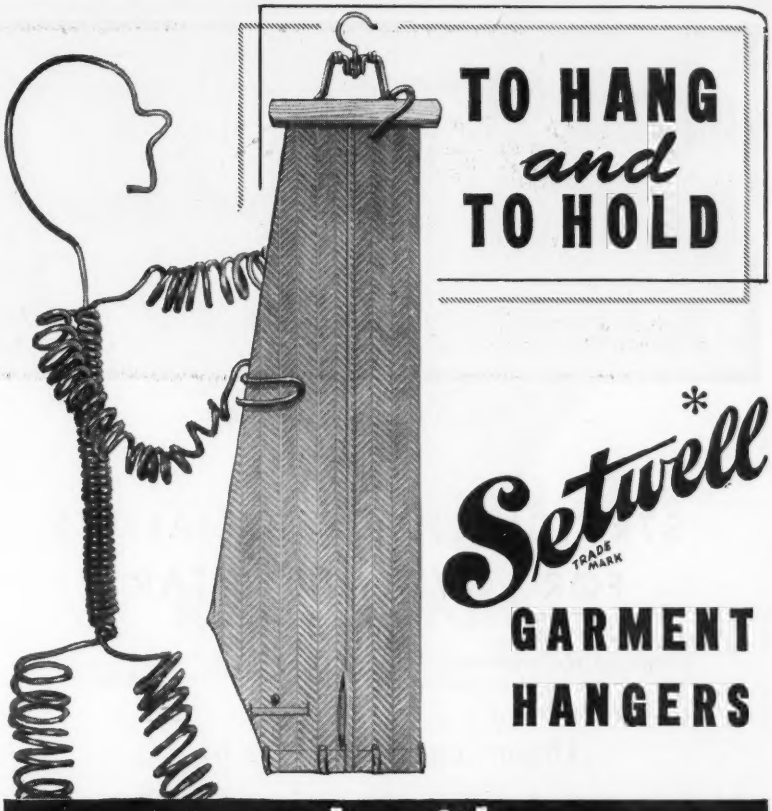
THE free acid can be neutralized by wire scrap, and the ferrous sulphate crystallized either naturally or in vacuum processes. This sulphate is good for killing dandelions; you put a pinch of it on the dandelion, watch it 'til it dies, and then brush it off before it kills the grass. Phooey. It will also purify a reservoir by killing the algae. Five pounds of it will kill all the algae in a big reservoir for a year. In other words, no market. You can burn it to red oxide, grind the oxide, and make it up into paint, and it's good for red barns. That's why all barns are red; the paint sells for a little less than nothing.

* * *

THERE is a fairly well developed process for burning the sulphate to an oxide that can be smelted, and converting the sulphurous fumes back into the acid that gave them birth. There is good promise that on a fair scale of tonnage it would return a profit. It has been suggested that several mills, each crystallizing its own sulphate, might recover the acid as a joint enterprise. Perhaps there is a solution here for such communities as Worcester.

* * *

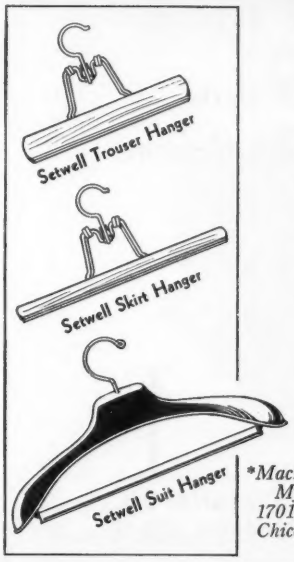
THE Special Correspondent has seen, in Europe, several recovery schemes in which crystallization was induced out of strongly acid solutions, so that the mother liquor, fortified by fresh acid, could go back into the tubs. His queries as



TO HANG *and* TO HOLD

Setwell* TRADE MARK GARMENT HANGERS

made with KEYSTONE WIRE



Setwell Hangers keep your trousers neat, trim and wrinkle-free . . . and prolong the life of each garment.

The nickel-plated steel wire uprights are sturdy and strong . . . hold their shape and bright finish for years. The Keystone wire used in their construction must be stiff enough to support the garment . . . yet have the proper ductility to withstand the severe twisting during forming. The wire, of course, must be free from all surface defects . . . uniform in cross-section and temper. Other Setwell products require the same critical choice of materials and expert craftsmanship.

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KEYSTONE MUSIC SPRING WIRE

SPECIAL ANALYSIS WIRE for all industrial purposes

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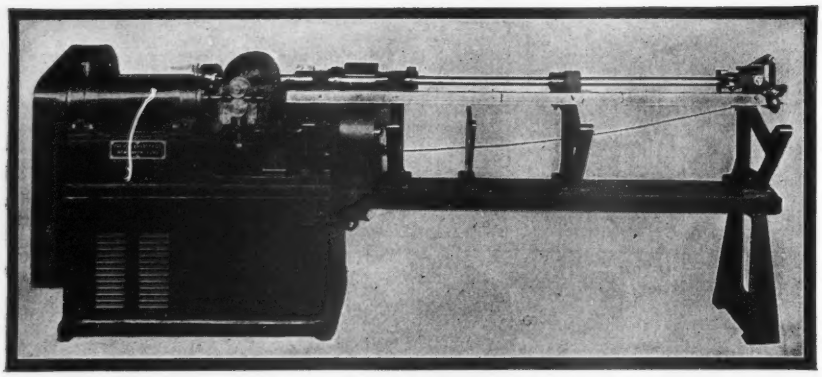
PEORIA 7, ILLINOIS



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STRAIGHTENER SPECIALISTS
FOR OVER 80 YEARS

Some of the refinements developed in that time—

Almost continuous wire travel
Lightening cut-off that assures square ends.
High-speed, direct-driven 5-die straightening flier
Quiet, efficient V-belt drive
Ball & roller bearings thruout
Extreme rigidity
Types for capacities from 1/32" to 11/16" diameter

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THE F. B. SHUSTER MFG. COMPANY, INC.
3102 MILL RIVER STREET, NEW HAVEN, CONN.

SHUSTER SINCE 1866
Automatic WIRE STRAIGHTENING AND CUTTING MACHINES

to their cost and the market for the by-product were always met with shrugs of the shoulders and rolling of the eyes. One plant was most enthusiastic over the profits, but the Special Correspondent found later that it was the agent for the patentee.

* * *

AT the Worcester meeting one of the members, rising after a moving plea from a piscatorial pervert, sought to introduce a lighter note by reminding the audience that the addition of fertilizer to fish ponds had been found to accelerate the development of the fish, presumably by stimulating the health of the marine flora on which they fed, and suggested that it would be well if we could convert the waste into some form of plant food, thereby pleasing everybody. To his surprise, and that of the Special Correspondent as well, Mr. Queern stated that the neutralization of pickle liquor with ammonia had been not only proposed but tried, and that the end products were ammonium sulphate, notoriously a favorite provender among the plants, and a magnetic oxide of iron which could be very useful in the production of iron in powder form. There was much wistful prophecy along this line but unfortunately nobody had any facts.

* * *

DR. DiGuilio had no difficulty holding the interest of the meeting with a description of a method of coating wire and other steel products with aluminum by the hot-dip process. It has been recognized that the pronounced electro-negativity of this metal to iron exceeding both zinc and even cadmium, not to mention its abundance and its low cost relative to its covering potentiality, made it intensely interesting to the galvanizer, but its use has been balked by its avidity for oxygen, and its propensity for eating out the iron kettle.

* * *

DR. DiGuilio's sponsors, Upton Electric Furnace Co., seem to have the matter fairly well in hand. They use a brick kettle, with an electrode flush with each end wall and a current that melts and keeps at proper heat a bath of fused salt,

which, in turn, melts and heats a pool of aluminum that floats on top of the salt. The salt creeps up along the brick walls by capillarity keeping the brick and metal apart, and joins a blanket of fused flux, of the usual nature, over the top of the bath. Wire is supposed to be annealed, pickled, and fluxed in the usual way, to pass under sinkers, through wipes of asbestos, and to the blocks.

* * *

THE usual bonding alloy occurs, the aluminum can be wiped thinner than zinc, perhaps two-thirds the thickness, and the product submits to drawing after coating. All grades have been coated, and the samples looked very attractive. Nothing has been attempted on anything like a commercial scale; it can only be said that the principles seem to be sound.

* * *

THE melting point of aluminum introduces several interesting thoughts. Annealing might be done right in the coating bath, and on the other hand it might be impossible to coat spring or rope grades without destroying their valued properties.

* * *

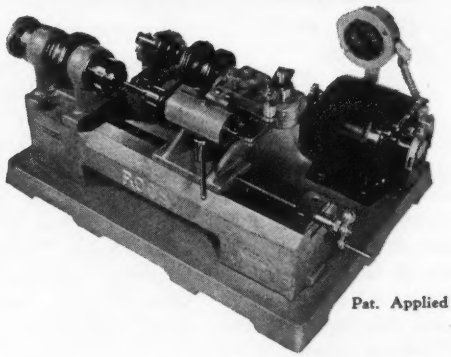
Booklet on Induction Heating

THE American Gas Association, 420 Lexington Avenue, New York 17, N. Y., has issued a 48-page booklet entitled "Induction Heating in Relation to Industrial Gas Heating", priced at $1.00, covering direct and indirect gas heating, induction heating and a metallurgical and economic appraisal of gas and induction heating.

* * *

THE treatise has been prepared by S. L. Case, L. R. Jackson and R. J. Judd of the Battelle Memorial Institute of Columbus, Ohio. It is a complete, illustrated technical paper of interest to those whose problems involve the surface hardening of steel, heating for hot working, the heat treatment of steel and the heating of nonferrous alloys.

NEW DIE FINISHING MACHINES
For the Die Room



Pat. Applied For

Roos "DYKREX" Fully Automatic Polisher

"It Corrects the Die"

- Saves labor, saves time
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  More dies per day.
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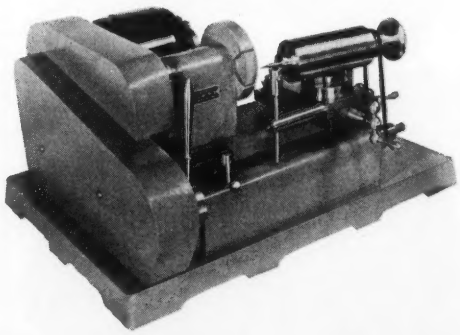
Roos Precision Pin Grinder



A machine that any Die Room employee can operate and make the finest lapping pins in less time and at less cost than a skilled mechanic.

ROOS TOOL & MFG. COMPANY
17-19 GROVE STREET
Montclair, New Jersey

Outstanding Personalities of the Wire Industry

E. L. Klingler
Wire Rope Sales Engineer
The Colorado Fuel and Iron Corporation

N. H. Orr, Vice President in Charge of Sales announces the appointment of **E. L. Klingler** as Wire Rope Sales Engineer for **The Colorado Fuel and Iron Corporation.** In his new capacity he will continue supervision of expanded sales engineering force in addition to acting as assistant to **A. S. Rairden,** Wire Rope Sales Manager of the Corporation at Palmer, Mass.

* * *

MR. Klingler has been continuously associated with the wire rope industry after being graduated from Bucknell University with a Bachelor's degree in Chemical Engineering in 1929. Since that time he has been employed in all phases of the wire rope industry including sales, engineering and production.

Staroba Appointed Midwestern District Manager for Carboloy Co.

APPOINTMENT of **F. J. Staroba,** formerly sales engineer for **Carboloy Company, Inc.,** to the position of Manager of the Midwestern District for Carboloy, with headquarters in Chicago, has been announced by K. R. Beardslee, Vice President and Marketing Manager of Carboloy Company, Inc., Detroit. Staroba succeeds W. D. Bronson, who recently resigned to form his own company.

* * *

MR. Staroba has been with Carboloy for 11 years — first in the Engineering Department and then in the Chicago district office. During the past 6 years, Staroba has been active in sales engineering on Carboloy hard metal products in the industrial area of Chicago, Milwaukee, and St. Louis.

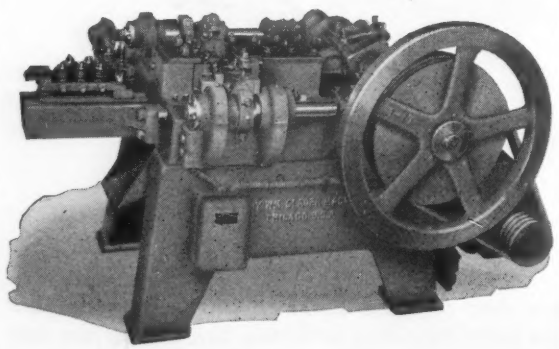
Opens Enlarged Laboratory

JOHNSON Steel & Wire Company has opened an enlarged laboratory at the Worcester plant with **George E. Seeley,** B.S. and M.E., University of Maryland, in charge. Two important functions in the wire industry are the primary objectives of this laboratory. One is the scientific study of any user's problems on wire, and the other is quality control within the Johnson plants. Mr. Seeley has had wide experience in the wire industry. The laboratory is equipped to break down steel, to make chemical analyses and physical analyses, microphotographs, etc. The work of the laboratory will include the developing of new products as well as improvement in present manufacturing processes.

* * *

THOMAS Nolan, graduate of Worcester Polytechnic Institute, chemical engineering, has been

GLADER HIGH SPEED WIRE NAIL MACHINE



MACHINE ARRANGED FOR INDIVIDUAL MOTOR DRIVE

High tonnage output, and low maintenance costs, have resulted in Glader Machines being accepted as standard equipment in every large nail mill built in the United States in the past twenty years.

Glader Machines are operating in most of the wire producing mills throughout the world.

These machines are made in eleven different types and sizes. This enables us to cover the range of sizes of nails produced with the greatest efficiency.

For further information please address,

WM. GLADER MACHINE WORKS
210 No. Racine Ave.
Chicago 7, Illinois

Export Dept.: 122 E. 42nd Street, New York 17, N. Y.

named sales engineer for Johnson Steel & Wire Company. He will travel to the plants of the ultimate users of Johnson wire and study proceses with the idea of suggesting product improvement through the use of specific laboratory controlled wire.

* * *

JOHN W. Hill has been named Johnson west coast representative with headquarters in Los Angeles.

* * *

TO further distribution, Johnson offices have been established in Atlanta, Georgia; Houston, Texas; and Tulsa, Oklahoma.

* * *

Slenker Becomes General Superintendent of Duluth Works

JOHN A. Slenker has been appointed general superintendent of the Duluth (Minn.) Works of **American Steel & Wire Co.**, U. S. Steel subsidiary. He succeeds F. J. Martin, deceased.

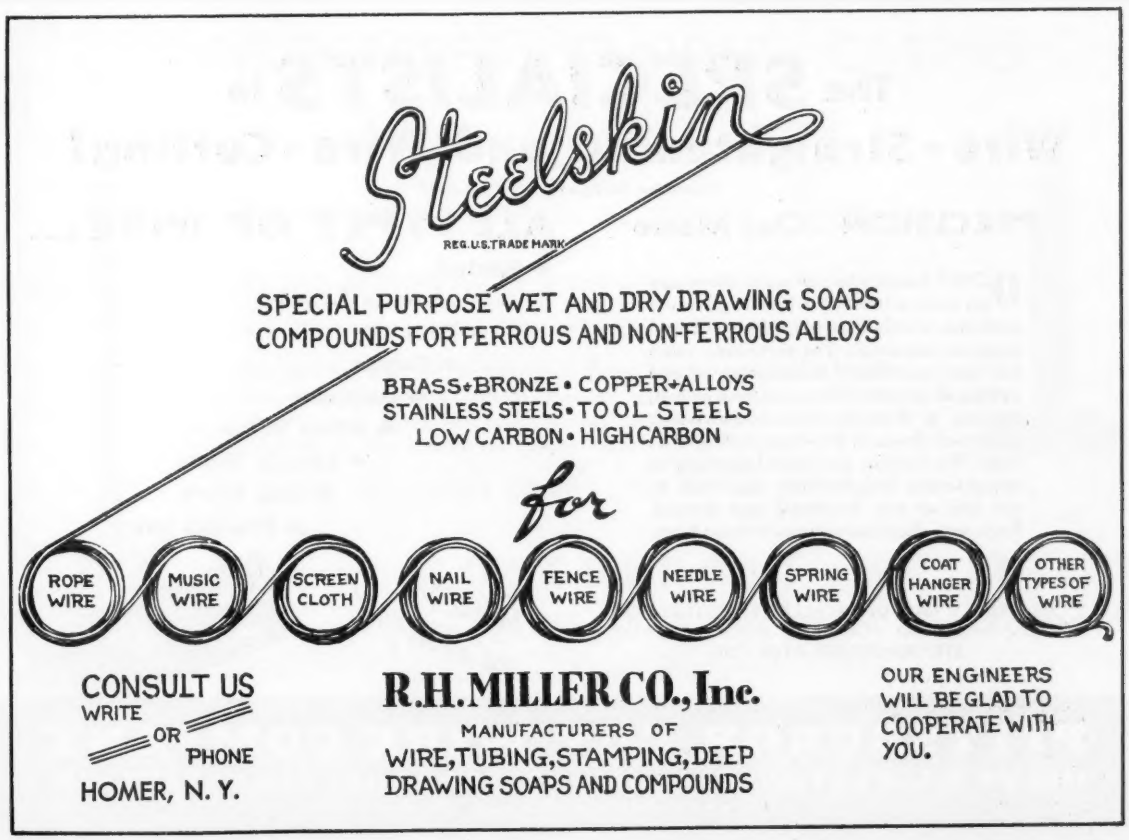
* * *

MR. Slenker is a native of York, Pa., having been born there on November 19, 1907. He attended public schools in that city before matriculating at Penn State College from which institution he was graduated with a B. S. degree in metallurgy. His first business experience was with the York Ice Machinery Co. He subsequently worked for the Aluminum Co. of America and Jones & Laughlin Steel Corp. before joining the American Steel & Wire Co. in June, 1935, as assistant metallurgist at the Donora, Pa., Works. In November, 1940, he was transferred from the position of superintendent of the open hearth in Donora to the job of Cleveland division metallurgist of the Wire Company. In June, 1942, he was moved to South Works, Worcester, Mass., as superintendent of the Steel Works. Since August, 1945, Mr. Slenker has been assistant general superintendent at Duluth.

SEND IN
YOUR ORDER NOW
for the
1948 WIRE BUYERS GUIDE

128-Year-Old Plating and Polishing Supply House Appoints New Officers

THE **Hanson-Van Winkle-Munning Co.**, is one of the largest organizations in the world devoted exclusively to the manufacture of equipment and supplies for the electroplating and metal polishing industries. It was founded, originally, as the Hanson & Van Winkle Company, in Newark, N. J., in 1820. The present company is the outgrowth of a merger in 1927, of the Hanson and Van Winkle Company and A. P. Munning and Company. The latter company was formed by members of the George Zucker Company of Newark, N. J., and the Munning-Loeb Company of Matawan, N. J.



THE Hanson-Van Winkle-Munning Company, Matawan, New Jersey, manufacturer of electroplating and polishing equipment and supplies, announces the appointment of officers at the Annual Directors' Meeting held at Matawan, New Jersey on April 15, 1948. The following changes were announced.

Van Winkle Todd, who previously served as President, was appointed Chairman of the Board of Directors.
Guerin Todd, former Vice President, was appointed Vice Chairman of the Board.
Louis M. Hague, former Vice President, was appointed President.
John A. Bauer, former Sales Manager, was appointed a Vice President, assuming many of the duties for which Mr. Hague was previously responsible.

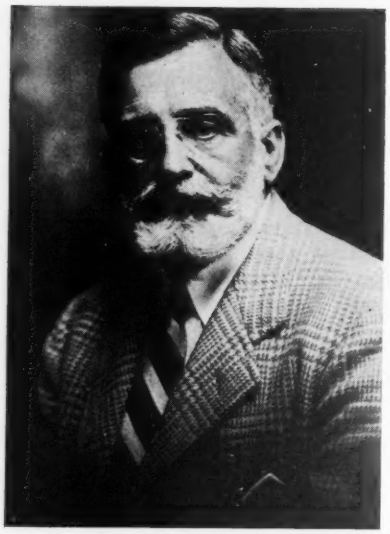
All of the above listed officers have been with the Company 20 years or more.

* * *

VAN Winkle Todd became associated with the Hanson & Van Winkle Company in 1927 and was its President at the time of its consolidation with A. P. Munning & Co. in 1927, to form the Hanson-Van Winkle-Munning Company of which he has served as President since that time. He will continue to maintain an active participation in the affairs of the Company.

* * *

LOUIS M. Hague, the new President, has spent most of his life in the electroplating industry. He joined the staff of the Hanson-Van Winkle-Munning Company in 1928. Mr. Hague has served successively in various sales and service capacities, and since 1939 has been a Director and Vice President in charges of sales.



Van Winkle Todd, Chairman of the Board of Directors, The Hanson-Van Winkle-Munning Company. * * * * *

Louis M. Hague, President, The Hanson-Van Winkle-Munning Company. * * *

The SPECIALISTS in Wire-Straightening and Wire-Cutting!

Diameter Range — 1/16" to .005"

PRECISION - Our Motto

DON'T hesitate to call on us when you are confronted with wire-straightening problems involving close tolerances and absolute accuracy. For seventeen years we have specialized in straightening and cutting all gauges of fine wire, hard or soft, ranging in diameter from one-sixteenth of an inch down to five-thousandths of an inch. We employ gun-barrel accuracy in straightening lengths from one inch to ten feet or any fractional part thereof. Ends cut absolutely clean without burrs.

ASK ABOUT OUR UNEXCELLED FACILITIES FOR CLEANING AND POINTING WIRE ALREADY STRAIGHTENED AND CUT.

ALL TYPES OF WIRE...

- Nickel
- Stainless Steel
- Bronze
- Brass
- Copper
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- Music Wire
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- Florist Wire

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TELEPHONE: CEdar 4702

A. S. & W. Makes New Appointments

LAWRENCE F. Black has been appointed assistant chief engineer of **American Steel & Wire Co. Charles B. Hull** has been named assistant division engineer-construction of this same U. S. Steel subsidiary.

* * *

MR. Black was born in Pittsburgh, Pa., on September 9, 1907, and attended the public schools at Donora, Pa., before entering Carnegie Institute of Technology where he majored in civil engineering. His first experience with American Steel & Wire Co. began in 1924 when he was hired as a clerk at the Donora, Pa., Zinc Works. The following year he moved over to Donora Wire Works as a layer out. He subsequently held a variety of jobs at both the Zinc Works and Wire Works before being transferred in May, 1943, to Duluth, Minn., as general master mechanic. Since January, 1945, Mr. Black has been superintendent of engineering and maintenance at Duluth, which post he now leaves to assume his new duties.

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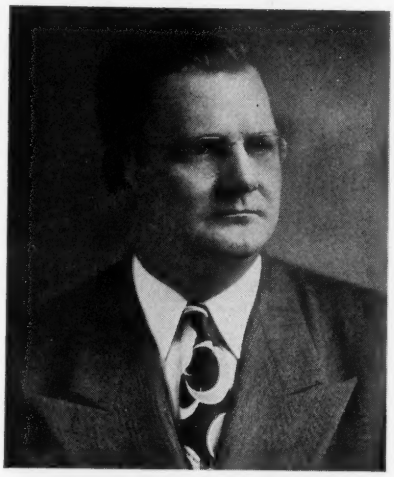

L. F. Black, Assistant Chief Engineer, American Steel & Wire Company. * *

MR. Hull is a native of Onaway, Mich., and was graduated from the University of Michigan with a B. S. degree. He has been with the Wire Company since July, 1925, when he started as a draftsman in the chief engineer's office in Cleveland. He progressed through the ranks and was works engineer at Cuyahoga Works in Cleveland prior to his appointment in June, 1945, as chief draftsman in the engineering department, the position he has held up to the present time.

* * *

National Screw & Mfg. Co. Appoints

FRED G. Hodell has been elected a director and vice-president of the **National Screw & Mfg. Co.**, Cleveland, following the merger of the Hodell Chain Co. **Charles F. Newpher** has been elected executive vice-president.

Patented

2 BX Mossberg Carrier

MOSSPEED BRAIDER CARRIERS

Represent

Improved Braiding at Lower Costs

The patented MOSSPEED spring tension take-up makes it possible to increase the speed of the maypole-type braiding machine. An effective increase of 80% being obtained in many cases.

The new (x) type MOSSPEED high speed carrier permits the rapid changing of tension springs making this an ideal carrier for braiding all kinds of yarn (cotton, rayon, asbestos, jute), in addition to fine strands of copper wire.

Consult our engineers regarding your braiding problems.

2 SE Copholder

Complete line of both MOSSPEED carriers and metal copholders for all sizes and makes of maypole type braiding machines.

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Pressed Steel Corp.

Attleboro, Massachusetts, U. S. A.

18 West Street

James Day (Machinery), Ltd., "Ford House," 88 Regent Street, London, W. I., England.

W. H. Brown
President, Hoskins Manufacturing Company

W. D. Little has retired as President and General Manager of the Hoskins Manufacturing Company, Detroit, but will remain on the Board of Directors, of which he was recently named Chairman. Mr. Little has been with Hoskins since 1912, serving most of that time as Sales Manager. He became President in 1944.

* * *

W. H. Brown, formerly Assistant General Manager, has been named President and Chief Executive Officer. He is a graduate of the College of Western Michigan and came to Hoskins in 1939 as technical assistant to the Factory Superintendent. His previous experience had been with General Motors, and with Ford where he worked for several years. At Hoskins he has served as Factory Superintendent and Assistant General Manager, and on the Board of Directors. He was given the post of top management April 1. Mr. Brown is 37 years old.

* * *

W. H. Brown, President, Hoskins Manufacturing Company.

* * * *

Allegheny Ludlum Names L. H. Bittner Vice Pres. In Charge of Purchases and W. F. Detwiler Honorary Chairman of Company

W. F. Detwiler, who has been chairman of the board of **Allegheny Ludlum Steel Corporation** for the past 10 years, has been named honorary chairman, it was anounced here by H. G. Batcheller, president.

* * *

AT the same time, the election of **Lester H. Bittner,** director of purchases, to the newly created position of vice president in charge of purchases, was announced.

* * *

MR. Detwiler, a pioneer in Allegheny Steel Company, served in positions ranging from maintenance to company president. He became chairman of the board of Allegheny Ludlum Steel Corporation when Allegheny and Ludlum merged in 1938. He will remain a director as well as honorary chairman.

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When in the market for cable lacquers, insulating finishes, or impregnating compounds, consult us and have at your command:

1. SPECIALIZED RESEARCH EXPERIENCE
2. RECOGNIZED AND WELL EQUIPPED LABORATORIES
3. SUCCESSFUL PERFORMANCE RECORDS
4. CONFIDENTIAL TEAMWORK

and

5. 77 YEARS OF KNOWING HOW

Our Hot Melt, *Flame Resistant, Non-Toxic* Compounds are most widely used for AF and CF wires.
Your inquiry is invited.

STANDARD VARNISH WORKS

Engineers of Product Finishes

NEW YORK — LINDEN, N. J. — CHICAGO

Serving Industry For 77 Years

MR. Bittner has been associated with the steel industry for 33 years. He joined the Hussey Binns Steel Company in 1915. Five years later he became associated with an Allegheny Ludlum predecessor, Atlas Steel Company (now the company's Dunkirk, N. Y., plant) as purchasing agent. Mr. Bittner returned to Pittsburgh in 1942 when he assumed his position as director of purchases. He is a member of the Purchasing Agents Association of Pittsburgh.

* * *

Firth-Sterling Adds Vestal to Staff

FIRTH Sterling Steel & Carbide Corporation, McKeesport, Pa., announced recently the appointment of A. B. Vestal to their management's staff effective May 1st. Mr. Vestal graduated from Carnegie Tech in Metallurgical Engineering. He formerly worked at Jones & Laughlin as a Power & Fuel Engineer. During the past eight years he served as head of industrial engineering of both the Farrell and Duquesne Plants of Carnegie Illinois Steel Corp. and more recently served on the company staff.

A. B. Vestal, Firth-Sterling Steel & Carbide Corporation.

* * * *

A. S. Rairden
Wire Rope Sales Manager
The Colorado Fuel and Iron Corporation

N. H. Orr, Vice President in Charge of Sales announces the appointment of **A. S. Rairden** as Wire Rope Sales Manager for **The Colorado Fuel and Iron Corporation,** its Subsidiaries and Divisions. He joined the Wickwire Spencer Steel Division in October 1933 as Wire Rope Sales Engineer and became Wire Rope Sales Manager of Wickwire Spencer Steel Company prior to its merger with The Colorado Fuel and Iron Corporation.

* * *

MR. Rairden is a 1922 graduate in metallurgical engineering of the Massachusetts Institute of Technology and has been connected with the wire rope industry ever since his graduation, filling various key positions in production, engineering and sales. He will continue to operate from Palmer, Mass.

WEAN EQUIPMENT Corporation

THE WEAN EQUIPMENT CORPORATION are recognized as specialists in high-efficiency strip and wire mill equipment.

COLD ROLLING MACHINERY

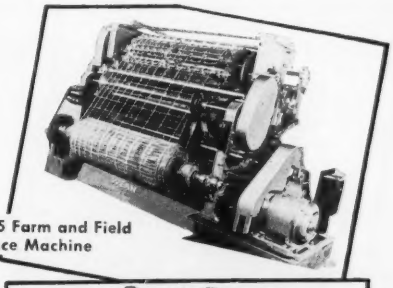
For 36" Wide Material and Narrower

MILLS - REELS - SLITTERS - LEVELERS
COILERS - EDGERS - SCALE BREAKERS - SHEARS
SCRAP BALLERS - CONTINUOUS PICKLING

WIRE MILL EQUIPMENT

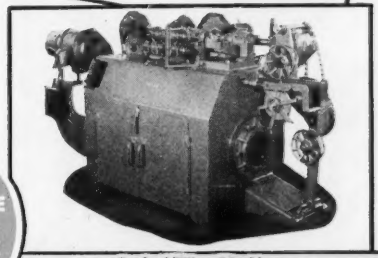
PATENTING, GALVANIZING AND TINNING TAKE-UP FRAMES
WIRE FLATTENING MILLS - SPOOLERS - NAIL GALVANIZING
AND BLUEING EQUIPMENT - FIELD FENCE AND
BARBED WIRE MACHINES

WEAN EQUIPMENT CORPORATION
22800 LAKELAND BLVD • CLEVELAND, OHIO

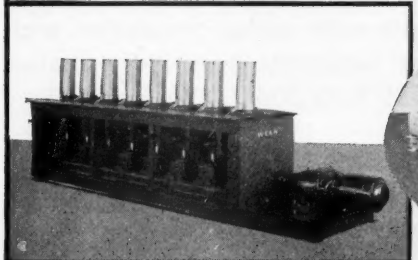


No. 1155 Farm and Field Fence Machine

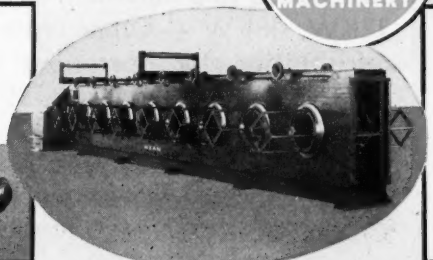
HOLMQUIST BARBED WIRE and WIRE FENCE MACHINERY



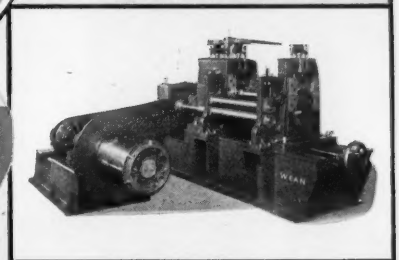
Barbed-Wire Machine



8 Block Fine Wire Tinning Take-up Frame



16 Block Wire Galvanizing Take-Up Frame



Strip Reel and Slitting Unit

A Review of Recent Wire Patents

No. 2,438,932, METHOD AND MEANS FOR TESTING CABLES, patented April 6, 1948 by Arthur Mahren, Long Island City, N. Y., assignor to Federal Telephone and Radio Corporation, East Newark, a corporation of Delaware.

The apparatus and method are for testing braided cable lines at high frequencies.

* * *

No. 2,438,949, ELECTRIC INSULATION COMPOSITION OF POLYVINYL CHLORIDE AND POLYALKYLENE POLYSULFIDE, patented April 6, 1948 by Thomas Robertson Scott and Archibald Alan New, London, England, assignors to Standard Telephones and Cables Limited, London, England.

A solid rubber-like electric insulating composition is provided, hard and tough enough for use as the external covering of field wire and free from plastic flow at ordinary atmospheric temperatures, and containing:

Plasticized polyvinyl chloride comprising equal parts of polyvinyl chloride and plasticizer — Two-thirds

A rubbery solid organic polysulfide consisting of the reaction product of an aliphatic dihalide with a water-soluble alkaline polysulfide —20%-30%

the remainder of the mixture comprising a rubber vulcanization accelerator to serve as a plasticizer for the rubbery solid organic polysulfide component.

* * *

No. 2,438,956, HIGH-FREQUENCY CABLE, patented April 6, 1948 by Arthur J. Warner, South Orange, N. J., assignor to Federal Telephone and Radio Corporation, Newark, N. J., a corporation of Delaware.

The wire conductors of the stranded coil are thinly coated, and the interstices between them are filled with, a soft flexible but solid low molecular weight polystyrene containing a low-loss plasticizer whereby no air spaces are permitted between and about the conductors and corona discharge is prevented together with a relatively high molecular weight hydrocarbon dielectric which is predominantly relatively high molecular weight polystyrene surrounding the coated core and bonded to the coating.

* * *

No. 2,439,272, MACHINE FOR MAKING WIRE STRAPS, patented April 6. 1948 by John Sholtis, Jr., Farrell, Pa., and Harold K. Embree, Hamilton, Ontario, Canada, assignors to Griplock, Inc., Hoboken, N. J., a corporation of Delaware.

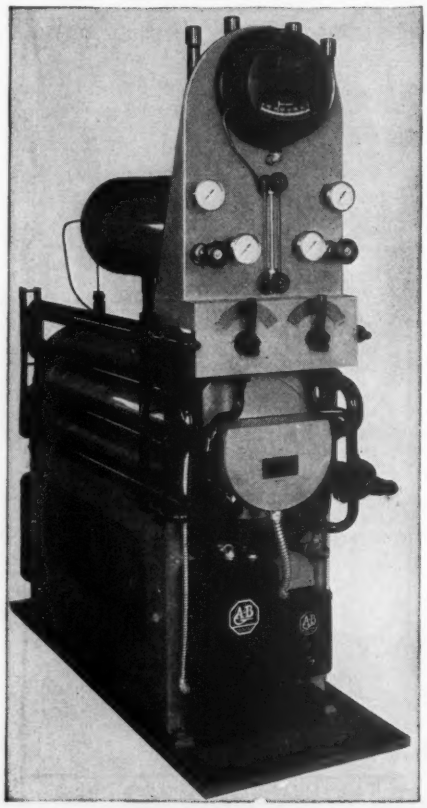
This machine includes a source of wire supply, a device for feeding wire therefrom, means for bending the end of the wire at an angle to the remainder thereof, rotary means for coiling the end of the wire backwardly around the wire as the latter is fed forwardly, and a device for varying the relative forward speed of the feeding means and rotary speed of the coiling means in order to vary the spacing of the coils with respect to each other and their angularity with respect to the wire around which they are coiled.

* * *

No. 2,439,283, BROILER GRILL, patented April 6, 1948 by Irving K. Bennett, Baldwin, N. Y.

The grill comprises a heavily calendered, fine mesh woven wire screen of the same thickness throughout, that is, approximately equal to the diameter of the wire and flat and smooth on both sides being composed of wires crossed at right angles and laterally spread at the points of crossing at both faces of the grill in flat ovoidal pads disposed at right angles to each other at the opposite faces of the grill at such points of crossing and forming smooth, flat, extended food supporting surfaces of materially greater extent than the diameter of the wire to support soft

Complete Description and Drawings of Patents May Be Had for 50 cents, outside the United States and Canada $1.00. Address, Wire & Wire Products, 300 Main St., Stamford, Conn.



THE ROYLE TEMPERATURE CONTROL UNIT

For Extrusion and Other Industrial Uses

A compact, simply operated unit designed to sustain any pre-determined temperature between 90°F and 475°F. — Hand-lever selection of desired temperature — Heat supplied — or drained — according to operational requirements — Formed piping, elimination of gaskets, and drip pans promote cleanliness — Breakdown of heat transfer oil reduced to a minimum — Three standard sizes 16KW, 32KW, 48KW — Other units with water circulation and refrigeration for operations requiring constantly maintained lower temperatures, 35°F to 200°F.

JOHN ROYLE & SONS

ROYLE PATERSON N. J. 1880

PIONEER BUILDERS OF EXTRUSION MACHINES SINCE

London, England James Day (Machinery) Ltd REgent 2430 | Home Office E. B. Trout J. W. VanRiper SHerwood 2-8262 | Akron, Ohio J. C. Clinefelter JEfferson 3264 | Los Angeles, Cal. H. M. Royal, Inc. LOgan 3261

PATERSON 3, NEW JERSEY

food and form smooth, sliding surfaces for any sharp edged implement used in lifting the food from the grill.

* * *

No. 2,439,424, METHOD OF PRODUCING COMPRESSED WIRE UNITS, patented April 13, 1948 by Alfred M. Goodloe, Montclair, and Otto H. York, Maplewood, N. J., assignors to Metal Textile Corporation, West Orange, N. J., a corporation of Delaware.

For the production of resilient washers, gaskets, bearing bodies and the like, the inventors provide a knitted wire mesh fabric which, after being arranged in relation to a forming mandrel, is shaped, collapsed upon itself in a forming mold and compressed to interlock the folds.

* * *

No. 2,439,789, UPHOLSTERY SPRING EDGE CONSTRUCTION, patented April 20, 1948 by Albert M. Bank, Jersey City, N. J.

This construction comprises the combination of a zig-zag spring, for mounting on a spring seat frame and a cantilever spring of new construction.

* * *

No. 2,439,893, FILAMENT COILING APPARATUS, patented April 20, 1948 by Fred B. Iden, Cleveland Heights, Ohio, assignor to General Electric Company, a corporation of New York.

More specifically, the invention comprises a cutter device for severing the wire, wound upon a mandrel from the wire guide.

* * *

No. 2,439,913, METHOD OF TREATING COILED TUNGSTEN FILAMENTS, patented April 20, 1948 by Johannes Antonius Maria van Liempt, Eindhoven, Netherlands, assignor to General Electric Company, a corporation of New York.

The method is directed to tungsten wire and is intended to give the coil high vibration-endurance and high extensibility in the direction of its axis at ordinary room temperature, as contrasted with poor corresponding characteristics without this treatment. It consists in maintaining the coiled wire at lattice-readjusting temperature until lattice-restoration has been effected before allowing the wire to reach a higher temperature that results in recrystallization.

* * *

No. 2,440,185, MACHINE FOR STRANDING WIRES, patented April 20, 1948 by Alfred James Prosser, Rochester, and Ernest Alfred Smith, Gravesend, England, assignors to W. T. Henley's Telegraph Works Company Limited, London, England, a British Company.

Included is new means for stopping the machine when the wire from any of the several reels comes to an end or breaks.

* * *

No. 2,440,507, BASKET STRUCTURE, patented April 27, 1948 by Jerry Geralds, Detroit, Mich., assignor to Mid-West Wire Products Company, Inc., Detroit, Mich., a corporation of Michigan.

The basket includes a rack forming an open mesh bottom comprising a frame, a series of spaced pairs of spaced metal bars extending across the frame and secured thereto, and a series of spaced upwardly-extending metal rods each having one end arranged between the spaced bars of each pair and rigidly connected at the end to each of the bars on opposite sides of each member.

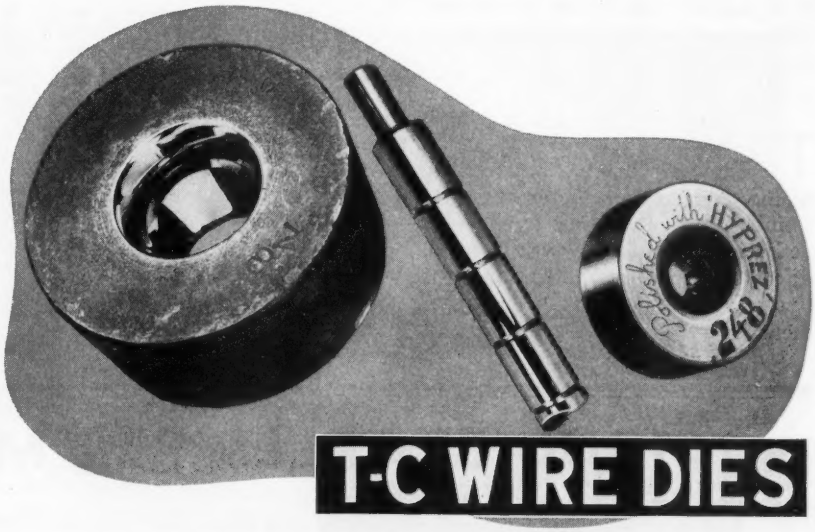
* * *

No. 2,440,668, CABLE CONSTRUCTION, patented April 27, 1948 by John P. Tarbox, Philadelphia, Pa., assignor to The Budd Company, Philadelphia, Pa., a corporation of Pennsylvania.

A process and cable blank are provided, and the process comprises forming a strip of insulation material with flexible divided strip extensions on each edge, positioning electrical conducting units on each side of this strip, folding over adjacent opposite edge extensions to form conducting unit-enclosing tubes of greater cross sectional area than the enclosed conducting unit and then sealing together the folded edges of the edge extensions.

ADVERTISING

is a service to a magazine's readers. Methods, materials and machinery were developed under the stress of war. Both editorial matter and advertisements keep you informed on what is happening in industry.



T-C WIRE DIES

Quickly and Economically
Finished to Perfection with

HYPREZ DIAMOND COMPOUNDS

Hyprez produces a perfect, lasting polish on Tungsten-carbide Dies, Tools, and Wear Parts — quickly, economically.

Precision-graded, clean, virgin diamond powders, accurately graded and fast cutting, are uniformly suspended in a patented compound base; will not fly off tool or die; stable and uniform at all normal temperatures.

Hyprez is a scientifically balanced product to match your finishing skill — available in 23 engineered standards. We will gladly recommend the proper grade for a complete and perfect job.

Supplied in fully color-identified dust-proof cartridges and sturdy applicator or in substantial container for conventional use, if preferred.

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ENGIS EQUIPMENT COMPANY
431 SOUTH DEARBORN STREET • CHICAGO 5, ILLINOIS, U. S. A.

Change in Company Name

THE name of The American Rolling Mill Company has been changed to **Armco Steel Corporation.**

* * *

THE new name describes the true nature and scope of their business as a fully integrated steel company. It also embodies the word "Armco" which, through long use as a trade name for our products and through wide advertising and publicity, has become better known and more widely used than the former Company name. The change, it is hoped, will prove a convenience to all with whom they have business relationships.

* * *

THIS change is one of name only. It does not involve any change in the Company's structure, its personnel, its policies or any of its activities. The change will have no effect on the rights and obligations under any agreements or arrangements to which they are a party.

I. D. R. Six Years' Index

A comprehensive index for the first 73 issues of 'Industrial Diamond Review', 1940-1946, has just been prepared and is on sale at 3/-. each. The Index contains the following sections: Key to Page Numbers, Authors Index, Name Index, and Subject Index. Great endeavours were made to make this index as comprehensive as possible, and in particular, all names have been checked with the originals to make sure that the index gives the correct version. The price of 3/- for the 20-page publication covers only a part of the printing costs. It is hoped that this work will help the practical engineer and scientist to trace older publications, and by making a precis on subjects of interest, to collect for himself valuable information without resorting to inquiries to manufacturers, etc. For copies please write to **Industrial Diamond Review**, 41 Tudor Close, Belsize Ave., London, N.W. 3, England.

TO WIRE MILL MEN
Have you considered joining the Wire Association? You are cordially invited to become a member. Dues are $15.00 a year, which includes a subscription to WIRE & WIRE PRODUCTS and a copy of the Annual Buyers Guide.

THE WIRE ASSOCIATION
300 Main St., Stamford Con..

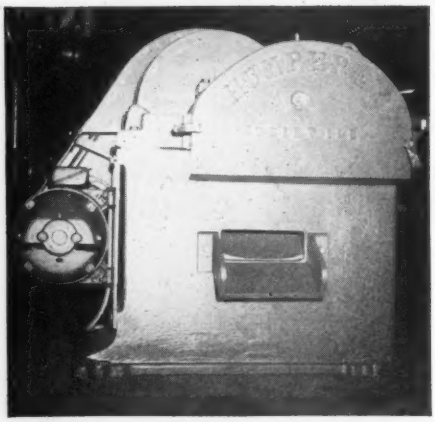
Disposal of Plating Room Wastes

WITH the increase in the volume of industrial electroplating there is an ever increasing problem in the disposal of wastes. Most chemicals used in the industry are poisonous and various laws have been passed to prevent these wastes from polluting streams. Public appreciation of the value of clean streams, lakes and ponds has brought this about.

* * *

ONE of the most poisonous of all plating room wastes is cyanide. This enters the stream as

1000 STAPLES PER MINUTE!!!



FENCE STAPLES — POULTRY NETTING STAPLES — DOUBLE POINTED TACKS (WIRE CLOTH TACKS)

Fastest Staple Cutter Ever Made — Makes Two Complete Staples at each revolution — Compact, Easily Adjustable, Efficient.

48 Different Leg Lengths, Gauges 9 through 18

Can Be Made With
HUMPHREY RAPID STAPLE CUTTER

Early Deliveries of Belt or Motor Drive Machines Now Possible. Send for complete details and prices.

Manufactured Exclusively For
REED and RICHARDS TRANSATLANTIC, Inc.
CHANIN BLDG., 122 EAST 42nd ST., NEW YORK 17, N. Y., U.S.A.
REG. CABLE ADD.. "LOUREED, NEW YORK".
Also Bale Tie Machines, producing single loop, round or oval ties, 2000 per hour; 3 to 16 ft.

dilute wash water and occasionally as a strong solution. Even very minute concentrations of cyanides are sufficient to kill fish life.

* * *

THUS industry is faced with a problem of destroying the cyanide in large volumes of waste water. The Research Committee of the A.E.S. has set up a project, under Dr. B. F. Dodge at Yale University, to study this problem. They seek to develop a method to purify economically the waste waters before discharging them into streams so that they are not harmful to fish.

* * *

SEVERAL alternate methods are actively under investigation in view of the fact that large plants may require different purification methods than small ones.

* * *

FOLLOWING the cyanide study, other poisonous waste problems will be investigated.

* * *

Booklet Describes Nickeloid Metals

A booklet featuring the widespread applications of pre-plated Nickeloid Metals has just been issued by **American Nickeloid Company,** and is available to any manufacturer, product designer, or sales executive who writes for it on his company letterhead.

* * *

THE booklet is illustrated with hundreds of photographs of products large and small which utilize these modern metals for decorative trim or for functional use. These applications range from the small metal tube clips or sifter tops to entire toys and electrical appliances using pre-plated Nickeloid Metals almost entirely in their design.

* * *

ILLUSTRATED also are the various forms in which Nickeloid Metals are offered — in sheets, in coils, in round edge flat wire — plated one or both sides in bright or satin finish, in color tints, and in patterns.

THE practical side of the use of these metals has not been neglected. A number of pages are devoted to listing the physical properties of the various metals in the line; also listed are sheet sizes, tempers, gauges, and a handy table of decimal weights.

* * *

WRITE American Nickeloid Company, Peru, Illinois, asking for Booklet G.

New Wheel Dresser Announced

THE **Hogland Engineering Co., Inc.,** 697 Selfmaster Parkway, Union, N. J. has perfected a new contour abrasive wheel dresser that is said to dress complex contours to .0002″ accuracy. It is portable and can be moved from machine to machine. The method employed is new. Copies of a bulletin describing the dresser will be mailed to our readers who desire it.

New improvements in ...
Assure better performance from...
NOPCO WIRE DRAWING COMPOUNDS

LIKE ALL NOPCO* DEVELOPMENTS, NOPCO metal working products are subject to *continuing* improvement through *continuing* research.

NOPCO LABORATORIES, for example, are now conducting an extensive research program with the primary purpose of effecting several improvements in NOPCO's brass, copper and aluminum Wire Drawing Compounds. Among these improvements are:

1. **Changing the structure of the fats and oils in these compounds, thus enabling them to create a *stronger* bond between metal and lubricant.**
2. **Producing *more stable* fatty compounds.**

THESE SPECIAL RESEARCH PROJECTS do not *supplant* . . . rather they *supplement* NOPCO's regular activities in the production of metal working products.

NOPCO INVITES INQUIRIES from Wire Manufacturers regarding the possible application of these new, improved Wire Drawing Compounds to their products.

*Reg. U.S. Pat. Off.

NOPCO TRADEMARK EVOLVED THRU RESEARCH

NOPCO CHEMICAL COMPANY, Harrison, N. J.
FORMERLY NATIONAL OIL PRODUCTS COMPANY
BRANCHES: BOSTON • CHICAGO • CEDARTOWN, GA. • RICHMOND, CALIF.

G-E Thermistors Announced

INTRODUCTION of G-E Thermistors, electrical semi-conductors that respond to temperature variations as small as one thousandth of a degree Centigrade, to General Electric's line of metallurgical products, is announced by the Metallurgy Division of the Company's Chemical Department. The devices are made from mixtures of semi-conducting metallic oxides and possess a high negative temperature coefficient.

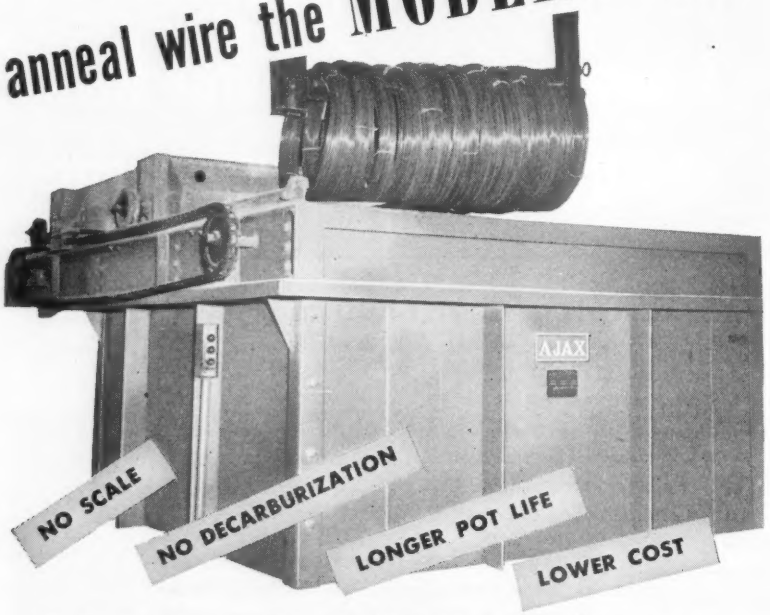
AVAILABLE in the form of rods, disks, and beads, G-E Thermistors are especially adaptable as the sensitive element in flow meters, time delay relays, switching devices, and other types of indicators and controls. Since they are pure electrical resistances, they can be used with either a-c or d-c current.

* * *

THE negative coefficient of resistance of G-E Thermistors may be used to offset the positive coefficient of resistance of conventional types of electrical conductors, and they can be used in instruments, meters, or other circuit components to correct errors caused by extreme temperature conditions. Highly sensitive to small temperature changes, G-E Thermistors are recommended as precision elements in aircraft engines, chemical and food processing equipment, and air conditioning systems, and domestic appliances.

* * *

anneal wire the MODERN way!



You'll save money, you'll improve efficiency along many lines with the unique Ajax Electric Salt Bath wire annealing method. It requires less floor space, less labor, less maintenance. Heating cycles average less than 20 minutes, even on difficult jobs. There is no scaling, no decarburization, no explosion hazard, none of the bothersome problems entailed with atmosphere equipment. Salt bath treating does the work faster, better, cheaper!

Ideal for annealing low- or high-carbon and stainless steel wire and rod; annealing aluminum, and copper and silver alloys; and for descaling stainless and alloy steel wire in molten salt baths.

AJAX ELECTRIC COMPANY, INC.
Frankford and Delaware Aves. · Phila. 23, Pa.
The World's Largest Manufacturer of Electric Heat Treating Furnaces Exclusively

WRITE FOR YOUR COPY!
This 72-page Ajax booklet tells the entire story of salt bath heat treatment as applied throughout modern industry. Ask for Booklet 116.

AJAX HUEGREN ELECTRIC SALT BATH FURNACE

Grasselli Chemicals Names H. J. Smith Assistant Manager Resale Section

THE Grasselli Chemicals Department of the E. I. Du Pont Company announces the appointment of **Howard J. Smith** as assitant manager of its resale chemicals section in Wilmington and of **Henry F. Koll** as manager of its district office at Charlotte, N. C.

* * *

MR. Smith was associated with the Grasselli Department for a period of years as branch manager and assistant district manager at Philadelphia before going to Charlotte as district manager in 1937. He comes to Wilmington from that post.

* * *

MR. Koll joined the Grasselli Department at its Cleveland laboratory in 1932 after receiving his B. S. degree in chemistry at the Case School of Applied Science in Cleveland. He worked in various technical and manufacturing operations at the Cleveland plant until 1943 when he transfered to the plant at Grasselli, N. J. In 1944 he became a technical service representative, with headquarters in Wilmington, and from 1945 to 1948 he worked out of the Philadelphia sales office.

Chase Brass & Copper Appoints

CHASE Brass & Copper Co., subsidiary of Kennecott Copper Corp., New York, has appointed Levinson Steel Sales Co., Pittsburgh, to handle its complete line of mill products in the Pittsburgh area.

Foreign Notes

THE reorganization of the Ruhr steel industry and the connected manufacturing industries, such as wire, etc., has been a complete failure. The "North German Iron and Steel Control" board, established on August 20th, 1946 by the British Government started in February 1947 with the decentralization. Up to now 20 independent companies have been established and approximately 10 more will follow. These new companies are owned by the British Military Government, which have established holding corporations, who have to look for private persons, desiring to run the companies under a "rent and lease act". However, up to now not one person has been found to venture. The reasons are multifold. First the capital. It has been decreed that it may not exceed 100,000 Marks ($10,000 at present bank rate of exchange), which is ridiculously insufficient. The British Military Government, unable to find interested parties, has used compulsory measures by establishing controlled and owned corporations, who accept the management under British control. The consequence has been the present disastrous state of production, which is only 40% of the permitted Potsdam-Treaty production line, whereas in the USA Zone the steel industry with approximately 6% of Germany's total capacity, is running at more or less 90% of the permitted outline.

* * *

THE greatest error was to split all companies in such a way that the pig iron and ingot works, the prefabricated manufacturers (such as wire rods, sheet plates, etc.) and the finished mills are separated. This deprives the latter one very often of all possibilities to get the necessary raw material, increases production costs and makes any rentability impossible. The wire production had been particularly hit. The present output is hardly more than 6,000 tons a month, everything taken together, whereas they produced approximately 70,000 tons monthly in 1939. It is absolutely forbidden to form any concern, which is built up "vertically", i.e., to include the whole production process in one hand. This, of course, is the end of the Ruhr steel industry, which always was organized in such a way, inclusive from coal to finished product, everything in one hand. It is impossible — not only because of lack of machinery and equipment, that the 5 to 8 million ton limit, agreed to at Potsdam could be reached, not to mention the 11 million ton limit annually planned.

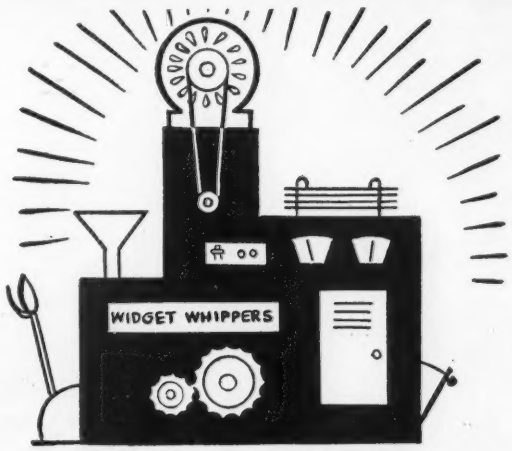
* * *

THE strangest thing is, that the shares of the big old steel works, such as Klöckner, Thyssen, Vereinite Stahlwerke, Krupp, etc., are still transacted at the British controlled and American controlled stock exchanges and at quite high rates, although the companies have not existed for a year and a half.

* * *

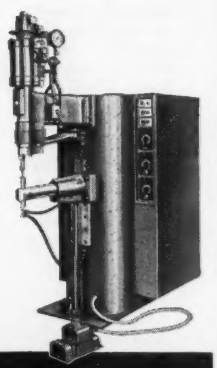
WIRE prices for export have been rising since the beginning of this year, mainly as a consequence of the increase of British, Swedish and also Belgian steel prices. The all around advance is approximately 5%.

Whether you make Whippers



. . . or pots and pans, or trucks, or stoves, or any product fabricated of metal . . . you'll be interested in the story of Mr. Widget. He was faced with the dilemma of wanting to use resistance welding but not having sufficient plant transformer and distribution facilities to handle the extra load. Also the power people frowned on the addition of a *low power factor* load.

How Mr. Widget became a "Man of Success" with the aid of "THREE PHASE" is briefly told in the booklet; "How Mr. Widget Made More Whippers." Your copy is waiting—just drop us a post card. You'll find it well worth the 3 minutes reading time (not counting technical stuff.)



Manufacturers of a complete line of resistance welders. Offices in New York, Detroit and Dayton. Representatives in Principal Cities

SCIAKY

SCIAKY BROS. Inc., 4923 WEST 67th STREET, CHICAGO 38, ILL.

EXPORT of barbed wire has been forbidden from Czecoslowachia, Poland and Hungary. The only wire product which is for export sale by these countries is wire nails, of which Czecoslowachia is exporting quantities without importance to the Near East.

* * *

THE J. E. I. A. has stopped all export permissions for non-ferrous wire products from Germany.

* * *

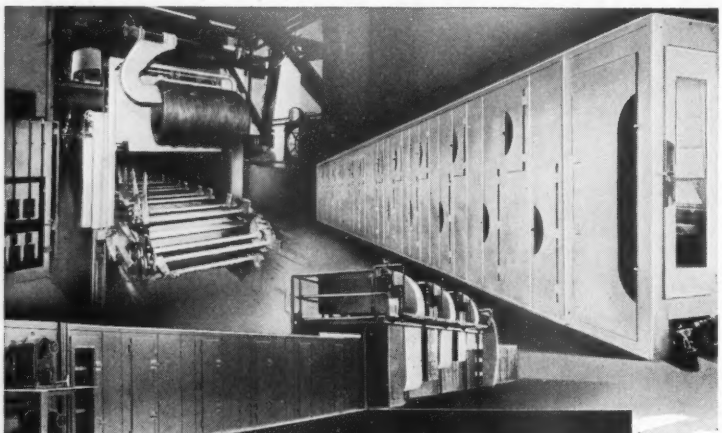
BOTH in Portugal and Spain there is a general downward trend of prices for wire products. Spain has three different quotations for steel products. First the official prices, which since 1939 have not been changed materially, second the prices at which semi-official business is done and permitted and third the black market. The official quotation for example for wire rods of 6 mm(¼") had been Pesetas 2.75 per kilos for 8 years. This at the official exchange rate would correspond to $ 230.- per ton; at the tourist exchange rate to $ 148.- and at the black market exchange rate to approximately 85.-. The semi-official price (at which 70-80% of all transactions are done) was Pesetas 4.50, but the black market price up to Pesetas 14.-, so that even when the black market exchange rate is taken into consideration, wire rods were sold at a price which was in the neighborhood of 400 dollars per ton. Now however prices have been going down so much, that the black market prices have nearly disappeared and are equal with the semi-official rate of 4.50. In Portugal the same happened.

* * *

GERMAN wire products, mainly wire mesh and wire netting are being exported by French Companies, which declare the products as "Made in Germany", or when the customer wants it as "Made in France" and provide original papers showing that the product is French. Not only products made in the French zone or the Saar-territory are thus exported, but also products from the American and Russian zone, brought into the French zone and exported therefrom at rather cheap prices. The main advantage the French offer, is that they have placed business in hands of private companies, which negotiate quickly and freely as every private organization, whereas the Bi-Zone JEIA (Joint export-import agency) is a phantasticaly bureaucratized organization, which needs for every little transaction weeks or months and only when hundreds of papers are filled. Therefore everybody tries to do business through the French companies and they pay for the products in marks at ridiculous quotations when the real value of the mark is taken into consideration, but prices, which still exceed those paid by the JEIA, make handsome dollar profits.

* * *

GENERAL demand for wire products on the export market has declined. Anxiousness because of the prevailing political situation is one of the reasons; the other is overstocking. Many countries in the Near East, Africa and also Latin America have filled their stocks and want to trade on compensation basis. Compensation business with the Bi-Zone is still probited, where-



Ross Wire and Rod Baking Equipment is operating in plants of Alloy Rods Co., Arcrods Corp., Gilbert & Bennett Mfg. Co., Harnischfeger Corporation, International Nickel, McKay Co., Metal & Thermit, A. O. Smith Corp., Westinghouse Electric and others.

Specify ROSS WIRE and ROD OVENS

For drying the coatings on steel and alloy rods or for baking lime coating on wire, ROSS equipment provides design refinements and operating advantages that greatly increase output of better finished products. This accounts for their use in the leading plants throughout the industry. Write to our office nearest you for complete details.

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as the Russian State agencies trade freely, selling needles (for instance cotton needles for the textile industry) safety pins, wood screws and cut tacks by compensation with Overseas markets. The curious fact is, that as the Anglo-American Bi-Zone still excludes trade with "Fascist" Spain the Communist Russian Zone has no objection to permit business with that country.

* * *

THE Czecoslowachian wire industry has stopped all export transactions with countries in Western Europe and Overseas. The reason is that Russian and Balkan States have placed very large orders for wire products of all kinds with the CSR industry, so that works are filled with orders.

* * *

Keystone Installs New Pension Plan

A formal pension plan reflecting cost of living changes and entirely financed by the Company was announced to **Keystone Steel & Wire Company** employees on April first by Reuben E. Sommer, President and General Manager.

* * *

IN making the announcement Mr. Sommer stated: "The Keystone Management has been convinced of the need of an adequate pension plan for its employees for many years. Keystone employees have contributed much to the Company's growth. Their years of faithful service are being rewarded. Under this plan, entirely Company financed, Keystone employees have the added security of fair and uniform pension payments at the time of their retirement and these payments will reflect changes in the cost of living. The pension plan payments will be in addition to the employees' rights to Social Security benefits."

* * *

UNDER the terms of the Pension Plan, effective April 1, 1948, all Keystone employees are eligible for a pension based on a point system. This awards one point for each year of age and one point for each year of service with the Company. Employees 65 years of age with 85 points qualify. Those with 80 points may apply, as well as those whose disability seriously interferes with their work.

* * *

MONTHLY payments will be computed on a formula allowing ¾ of 1% of the first $3000, of average annual income during the ten most productive years of an employee's service to the Company, plus 6/10 of 1% of his average annual income in excess of $3000, during that time. This is multiplied by the number of years of service, then divided by twelve to determine the monthly base figure. Based on the Consumer Price Index of 167 the minimum base pension is $45.00 per month.

* * *

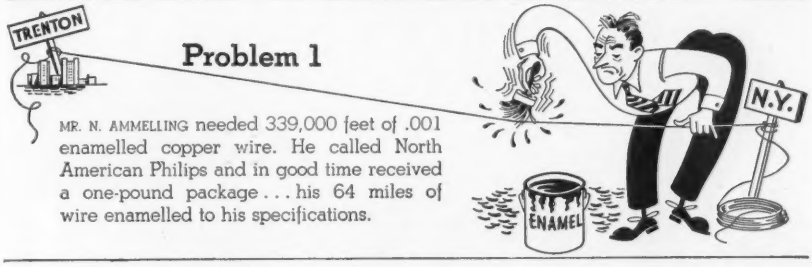
PENSIONS will reflect cost of living changes by being reviewed semi-annually in conjunction with the Consumer Price Index of the Bureau of Labor Statistics. Payments to pensioned employees will be revised at six-month intervals in the light of advancing or declining prices.

* * *

AS an example of payments under this plan, an employee with 40

What's your problem?

Fine Wire? Tungsten? Molybdenum?



Problem 1

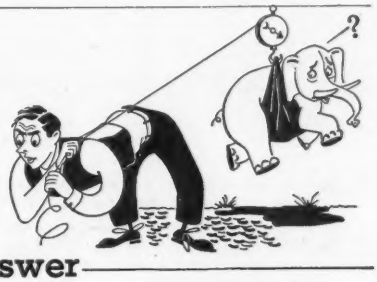
MR. N. AMMELLING needed 339,000 feet of .001 enamelled copper wire. He called North American Philips and in good time received a one-pound package . . . his 64 miles of wire enamelled to his specifications.

Problem 2

Mr. N. O. Emission, II, required plated grid wires. He solved his problem with a call to Fine Wire Headquarters. We shipped him some gold plated tungsten and molybdenum wires. Result: no secondary emission.

Problem 3

MR. E. LONG GATE wanted a quantity of Fine Wire to meet close specifications for tensile strength and elongation. Calling Fine Wire Headquarters, he soon received the order, filled to his exact specifications.



the answer

WHY not call Fine Wire Headquarters when you have a question about fine wire? We can't do the impossible, but we can do lots of things that can bring you the right fine wire for the job.

So—when you have a problem on Fine Wire, Tungsten or Molybdenum—wire, phone or write to North American Philips, makers of NORELCO Fine Wires, and ELMET Tungsten and Molybdenum products.

NORTH AMERICAN PHILIPS COMPANY, INC.

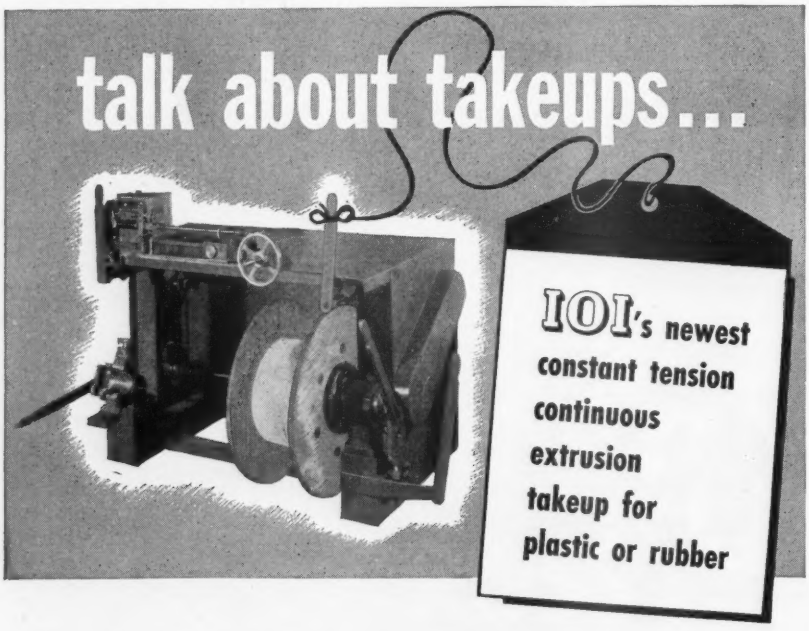
Dept. W-6, 100 East 42nd St., New York 17, N. Y.

years service and an average income during his ten best years of $5000, would be entitled to a monthly pension of $115 based on the Consumer Price Index at 167. If the Index rose to 200 at the time pensions are reviewed, payments for the succeeding six months period would be $138 per month. If the Index declined to 100, the monthly check would be $69.00 for the succeeding six-month period.

* * *

ANOTHER example of the working of this Pension Plan. Consider an employee with 25 years of service whose ten most productive years brought him an average of $3500. His pension based on the December 1947 Consumer Price Index of 167 would be $53.00 per month. If this Index advanced to be 200 at the time of the periodic review, the pensioned employee would be paid $64.00 monthly for the succeeding six-month period. If it declined to 100 from 167 his payments would be revised to $32.00 per month for the coming six months.

* * *



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E. M. Griffith Executive Vice President Of The Jessop Steel Company

EDWARD M. Griffith was recently appointed executive vice president of the **Jessop Steel Company**, according to an announcement by J. M. Lambie, president of the company.

* * *

MR. Griffith has been in the steel business 45 years and prior to the war was president of the Defiance Pressed Steel Company, Marion, Ohio. During the war he served as a civilian with both Army and Navy Ordnance and with the Army was in charge of the 20-mm. program.

* * *

MR. Griffith began his career with the Crucible Steel Company in Pittsburgh, working in operations and later with the financial department. He then joined the Union Drawn Steel Company where he became general sales manager in charge of its subsidiaries and was elected one of its officers. Before he became president of the Defiance Pressed Steel Company he served as executive vice president and general manager of the Cuyahoga Steel & Wire Company.

* * *

Stabilization of Austenitic Stainless Steel

AUSTENITIC stainless steels, of the type usually referred to as 18-8 (18% chromium — 8% nickel), are sometimes susceptible to intergranular embrittlement or corrosion. This type of corrosion is particularly pronounced in some 18-8 steels which have been subjected to moderately elevated temperatures — in the range 700 to 1400°F — and are either simultaneously or subsequently subjected to corrosive conditions. Experience has shown that the susceptibility to embrittlement may be decreased or eliminated, that is, the steels may be stabilized against intergranular embrittlement, by the addition of titanium or columbium, usually in conjunction with a stabilizing heat treatment. A diversity of opinion has existed, however, as to the relative amounts of titanium or columbium necessary for effective

stabilization of these steels, the injurious effect of carbon content, and the necessity for stabilizing heat treatments. Accordingly the National Bureau of Standards was requested by the Bureau of Aeronautics, Navy Department, to undertake a study of factors affecting the stabilization of the 18-8 type of steels.

* * *

USING both experimental and commercial steels made to a base analysis of 18% Cr and 10% Ni, the effect of variations in carbon content, in the ratios of columbium to carbon and of titanium to carbon, and of different heat treatments, was studied by Samuel J. Rosenberg and John H. Darr of the Bureau's thermal metallurgy laboratory.[1] The test ordinarily used to induce susceptibility to intergranular attack consists of heating the steel for 2 hours at 1200-1250°F (this is termed the sensitizing treatment), followed by exposure for 2 days to a boiling solution consisting of 100 ml H_2SO_4 (Sp. gr. 1.84), 100 g $CuSO_4.5H_2O$, and 900 ml distilled water. The specimens are then dropped on a steel plate to note whether they have lost their metallic ring, and are bent 180° over a rod whose diameter is equal to the thickness. The outer fibers are then examined for cracks. Steels which are immune to intergranular embrittlement have an unimpaired metallic ring and show no cracks after bending. Extremely susceptible steels lose their metallic ring completely and crumble on bending. In addition to these tests, all specimens studied at the Bureau were subjected to metallographic examination as well as a measurement of electrical resistivity, since intergranular corrosion increases this property considerably.

* * *

AS part of the investigation a variety of test conditions, some of them quite severe, were used to study susceptibility to intergranular attack. Specimens were sensitized at temperatures ranging from 840 to 1380°F for periods up to 21 days, followed by exposure to the boiling acidified copper sulfate solution for 14 days. It was found that the most severe sensitizing treatment was 8 or 21 days at 1020°F. Compared with this the commonly specified treatment of 2 hours at 1200°F is relatively mild.

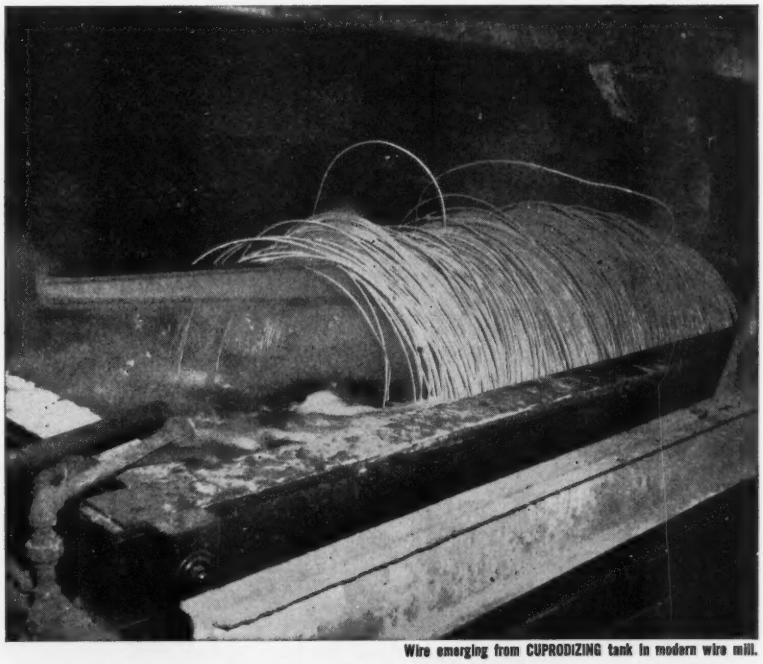
* * *

CONSIDERING the steels which contained no stabilizing elements, the tests showed that all were vulnerable to intergranular attack. Decrease in carbon content, however, decreased the degree of vulnerability.

* * *

IN the columbium and titanium-bearing steels, carbon content within the range of 0.06 to 0.13% had no influence upon the resistance to intergranular attack except as it influenced the Cb/C or Ti/C ratios. Steels varying in carbon content but having similar ratios of Cb/C or of Ti/C had approximately the same degree of susceptibility to intergranular attack re-

[1] For a complete technical account of this work see "Stabilization of Austenitic Stainless Steel" by Samuel J. Rosenberg and John H. Darr, J. of Res. NBS, RP1878, April, 1948.



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gardless of the total carbon content. The steels showed greater resistance to attack when annealed at 1800°F than when annealed at 1975°F.

* * *

STABILIZING heat treatments at 1600°F had a negligible effect upon the resistance to intergranular embrittlement of the columbium-treated steels so that steels carrying a sufficiently high ratio of Cb/C may be used without giving them a stabilizing heat treatment. However, the performance of the titanium-treated steels carrying the higher ratios of Ti/C was markedly improved by such treatments. When properly treated, substantially complete immunity to intergranular attack may be obtained with a minimum ratio of $Cb/C = 10$ and $Ti/C = 5$. For more "fool-proof" immunity, these ratios should be 12 and 8 respectively.

* * *

THE type of distribution of the precipitated carbides resulting from the sensitizing treatment was not an infallible indication of the resistance to intergranular embrittlement. Steels in which the carbides were distributed randomly were usually resistant to intergranular attack. However, steels that contained carbides at the grain boundaries, even though these carbides were distributed as a continuous network, either were or were not susceptible to intergranular attack, depending on the time-temperature relationship during sensitization. For example, two specimens of a straight carbon (0.09%) austenitic steel, one sensitized 2 hours at 1200°F and the other 2 days at the same temperature, were indistinguishable on examination of their microstructure (Fig. 1A and 1B). Both showed a precipitation of carbides at the grain boundaries and on various slip planes. Their behavior after exposure to the boiling acidified copper sulfate, however, differed radically (Fig. 1C). The specimen that had been sensitized 2 hours suffered severe intergranular corrosion after 2 days' exposure, while that sensitized for 2 days showed no evidence whatever of intergranular attack even after 14 days.

* * *

American Standards Association Announces Up-to-Date List of Approved Standards

THE American Standards listed have been developed through the procedure of the American Standards Association by the national groups in each of the fields covered, ranging from civil engineering, to chemicals and textiles. The "all party-at-interest" procedure of the Association has assured their acceptance by a consensus of all groups concerned and has given the standards included in this new list of "American Standards."

* * *

THE list includes national standards for such important problems as dimensions of machine tools and parts, rating and testing of electrical equipment, dimensions and identification of pipes and piping, building code requirements, industrial safety and health, occupational

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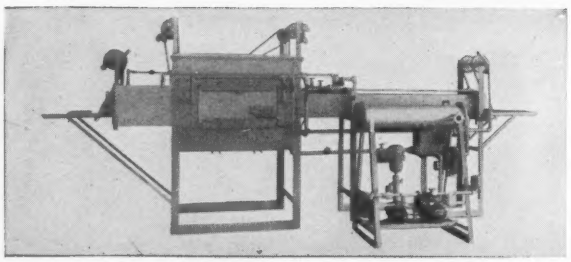

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The famed "Certain Curtain" control conquered the most difficult atmospheric problems in high speed steel treating. These same patented methods are available in equipment expressly designed for clean annealing, copper brazing and silver soldering at temperatures up to 2000°F. Conveyor and batch types. Additional external atmosphere generator available. "Certain Curtain" equipment dissociated ammonia or hydrogen assuring the utmost in economical protection for every operation.

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clothing, photography, and definitions, abbreviations and symbols used in technical literature.

* * *

THE new price list makes available a complete set of all American Standards at $225.00 and a complete set of all American Safety Standards at $35.00. Quantity discounts range from 20 percent to 45 percent for quantities up to 1,000 copies.

* * *

COPIES of the list can be obtained from the American Standards Association, 70 East 45th Street, New York 17, N. Y.

Columbia Steel Co. Appoints Three As Product Managers

COLUMBIA Steel Company, subsidiary of U. S. Steel Corporation, has announced the appointment of the following to positions as product managers in the distribution unit of the general sales department.

* * *

ROBERT R. Wolfenden, who will be responsible for tin mill products, including ferrostan, coke and charcoal, special coated manufacturing ternes, manufacturing ternes, and black plate.

* * *

R. E. Smice, who will be responsible for heavy products, carbon steel grades, including plates and shapes, bars and semi-finished, specialty products, and railroad products.

* * *

W. M. Jarrard, who will be responsible for wire products, including merchant products, manufacturers products, electrical products, wire rope and construction materials. He replaces Robert C. Baker, who will retire in June after 43 years of service in various capacities with United States Steel Corporation subsidiaries.

International Nickel Describes Operations

AT the annual meeting of stockholders of the **International Nickel Company of Canada, Ltd.**, in April, **Robert C. Stanley**, Chairman and President, gave some interesting facts on the company's operations.

* * *

IN 1947 205,278,868 pounds of nickel in all forms were sold, more than 4,000,000 over the sales for 1946. It cost the company $136,000,000 to operate in 1947, $81,000,000 of which was spent in Canada and $35,000,000 in the United States and $20,000,000 in Europe. The payroll includes 19,750 employees.

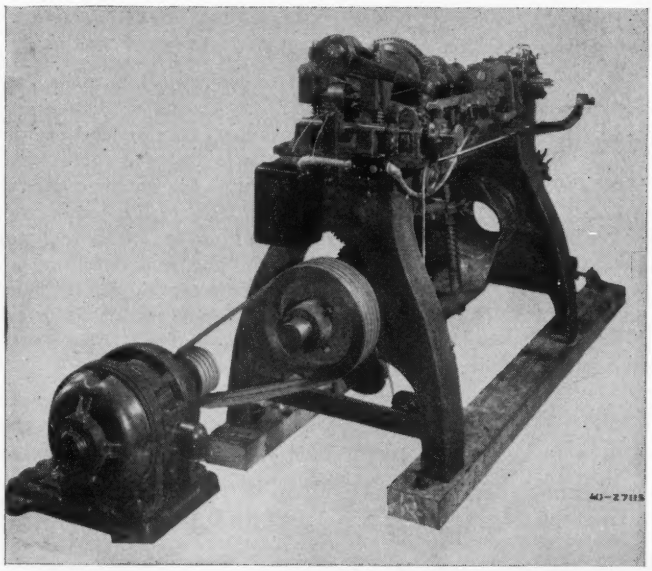
* * *

BESIDES nickel, the company produces copper and precious metals, the sales of the former running to 220,671,157 pounds in 1947. About 22,000,000 pounds of nickel, it was pointed out, were used in 1947 for nickel plating, exceeding the highest pre-war consumption by about 8,000,000 pounds.

* * *

THE steel industry consumed nearly 50% of the primary nickel sales, the largest use being for the manufacture of stainless steel, approximately 35,000,000 pounds. $9,563,796 was spent in 1947 for expanded production facilities, nearly three times the amount spent in 1946. Copper-nickel ore reserves seem ample, the company having proven about 221,843,000 tons of ore reserves as of the end of 1947.

GLADER BARBED WIRE MACHINE



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Machine can make 2-point or 4-point Barbed Wire. Both types can be made on the Glader Combination Machine. Changeover requires about 15 minutes.

Maximum production — One man can operate two machines easily, efficiently.

Glader Barbed Wire Machine also makes 2-strand plain cable wire, without barbs.

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solve your tinning problems

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STANNOCHLOR and STANNOUS SULPHATE are stable . . . will not deteriorate with age in summer or in winter. Their use makes it possible to keep a stock on hand at all times . . . permits purchasing in large quantities for economy.

And, because they contain no water of crystallization, STANNOCHLOR and STANNOUS SULPHATE go further pound for pound.

Write for more complete information.

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Lindberg Acquires Electronic Division, Illinois Tool Works

LINDBERG Engineering Company, 2444 West Hubbard Street, Chicago, manufacturers of industrial heat treating and melting furnaces, has acquired the assets of the Electronics Division of Illinois Tool Works, Chicago, and will continue the business of the manufacture and sale of high frequency induction and dielectric heating equipment, according to an announcement made by **C. H. Stevenson**, Lindberg vice president.

* * *

TEMPORARILY, operations will continue at the Illinois Tool Works plant until June 1, and then move into the Lindberg plant.

* * *

PRODUCTS manufactured by the division include induction heating equipment for hardening, annealing, soldering, brazing, and tinning metals. An established line of dielectric heating equipment for nonelectrical conducting materials is also manufactured. Included in this line is equipment for preheating, sealing, curing, forming, laminating and joining plastic materials. In addition, similar equipment is also built for laminating, joining and drying wood.

* * *

THIS completes the expansion program begun by Lindberg Engineering Company several years ago. As a result of this and other recent expansions a new building with a floor area of 15,000 sq. ft. will be erected on property adjoining the present Lindberg plant. Other Divisions acquired or originated in the last three years include the Laboratory Furnace Division, the Fisher Melting Furnace Division, the Transformer Division, the Air and Hydraulic Division, and the Refractories Division.

* * *

Du Pont to Expand Research Facilities

A $30,000,000 expansion of research facilities at the **Du Pont Company's** Experimental Station here has been approved by the Executive and Finance Committees and submitted for ratification to

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Model L-HDW-16

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SINCE 1879 — Speedometers OF INDUSTRY

the Board of Directors, the company has announced.

* * *

THIS is the biggest single laboratory project the company has ever undertaken. It will make the Wilmington Experimental Station, birthplace of nylon, neoprene, and other useful products, one of the largest research establishments in the world.

* * *

SOME of the company's research organizations now located elsewhere will transfer to the new facilities to be provided here. The ones already at the station are laboratories of the Chemical, Engineering, Grasselli and Ammonia Departments, the nylon laboratory and the Haskell Toxicological Laboratory. They will be joined by the Rayon Pioneering Laboratory, by research personnel of the Plastics and Pigments Departments and by additional Grasselli Department research activities. The number of chemists and other technologists at the station will be almost doubled when construction is completed.

* * *

New Bulletin on the 'Surface' Dew-Point Recorder

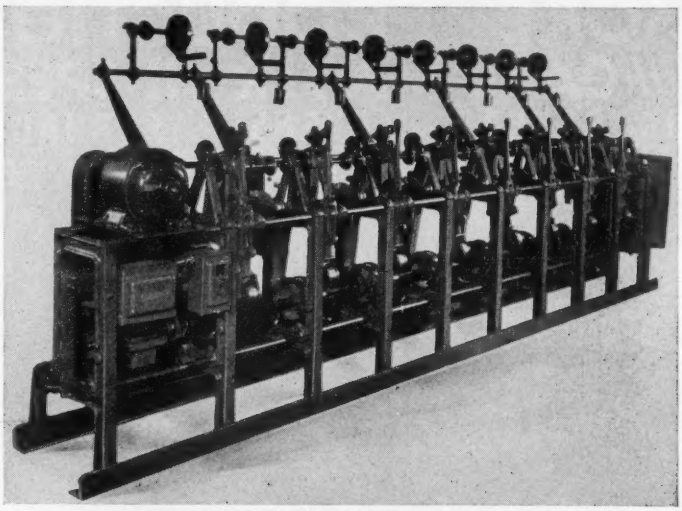
THE 'Surface' Dew-Point Recorder and the 'Surface' Atmosphere Selector are completely described in a new four page Bulletin SC-137, "The 'Surface' Dew-Point Recorder and Atmosphere Selector", just released by **Surface Combustion Corporation,** Toledo 1, Ohio.

* * *

THE bulletin describes the many industrial uses of the 'Surface' Dew-Point Recorder in the heat treat, chemical and food processing industries and also how it is used in connection with the transmission of natural gas.

* * *

THE bulletin is illustrated with installation photos, a schematic operational chart and a graph showing dew point versus per cent of water vapor by volume.



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Winds wire with maximum diameter of .080".
Accommodates spools up to 16" flange diameter.
Spool spindles can be started or stopped individually and traverse is adjustable for length over its entire range.
Other spoolers made to accommodate any size of wire and operating condition. Spoolers are also engineered to meet your special needs. Only finest workmanship and materials used.

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FOUR CLASSIFICATIONS OF WILLEY'S DIES

A. Blank and rough cored nibs.
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Standard Sizes from .325 to 4.000. Special Sizes and Shapes Made to Order.

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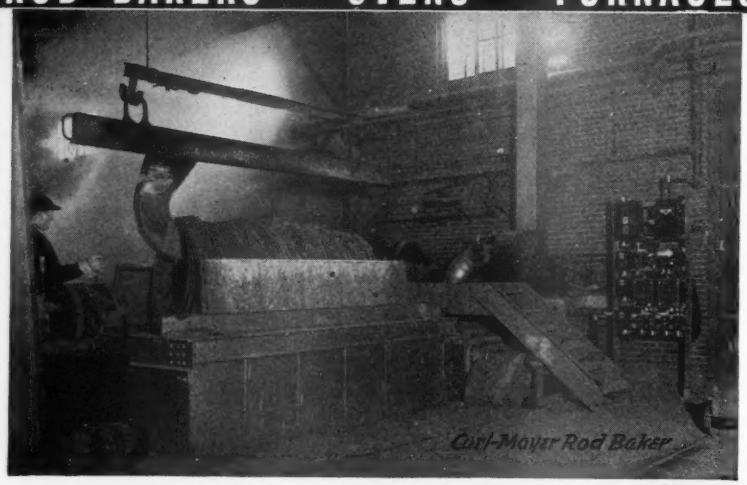

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Atlas Steel Co.
Atlas Tack Corp.
California Wire Cloth Corp.
Eaton Mfg. Co.
Frost Steel & Wire Co. Ltd.
Hollup Corp.
Johnson & Nephew Ltd.
Jones & Laughlin Steel Corp.
Pittsburgh Tool Steel Wire Co.
Republic Steel Corp.
Steel Co. of Canada
Wickwire Spencer Steel Div.
Page Steel & Wire Co.

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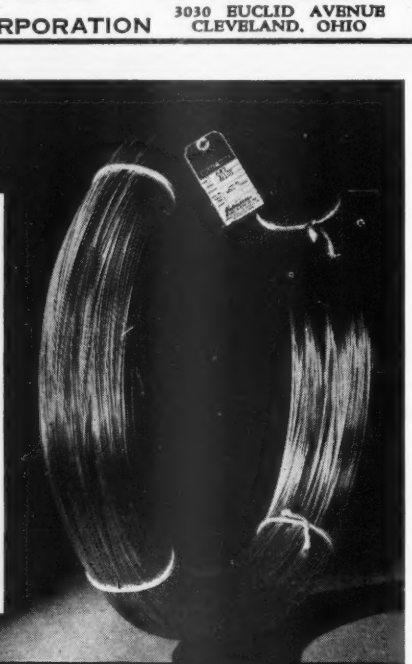
CLEVELAND, OHIO

Here is nationwide, streamlined service in high-quality specialty steel wires. You get fast action from any of the Johnson offices across the country .... sure of the highest quality when you specify JOHNSON. With an unfailing supply of premium steel.... controlled grain structure .... restricted analysis.

Warehouse stocks —Worcester, Chicago, Los Angeles.



JOHNSON
STEEL AND WIRE COMPANY, INC.
WORCESTER 1, MASS.

New York Philadelphia Cleveland Detroit Akron Chicago
Atlanta Houston Tulsa Los Angeles Toronto

New Solder Development

THE Solder Division of **Alpha Metals, Inc.**, announces a new development in acid core solders recently engineered by the research staff. This new product will be known as Alpha Tri-Core "Leak-pruf" Acid-filled Solder. Heretofore Tri-Core has been available only with the rosin-filled flux for radio and electrical work, which has met with phenomenal acceptance.

* * *

THE development of this hard acid is said to be the first innovation in the field of acid core solder since 1929. Some of the advantages of Alpha's new solder are:

Its ability to solder stainless steel, monel, nickel and other metals hitherto not usually solderable with a core solder.
Three cores instead of one — with no premium in price.
The synthetic acid used is considerably more active as a flux than the usual zinc chloride, yet only half as corrosive. Furthermore, it is readily soluble in water, and is easily washed off.
A definite soldering sequence is automatically developed by three cores of flux. Hence "cold solder joints" are practically eliminated. There is always the proper volume of flux at the moment the solder begins to flow to assure a perfect bond. The three core construction promotes faster melting. The flux insurance and the increased melting speed result in stronger, more dependable bonds.

* * *

IN developing this new core solder, Alpha Metals has produced a flux that is not a zinc chloride, yet it is much more active in its ability to solder metals. Though only half as corrosive as zinc chloride, this new solid acid flux will solder such metals as stainless steel, nickel, and monel. Tests show that the only metals which this flux will not solder are aluminum and magnesium.

* * *

THE manufacturer points out that the technique of using a core solder is quite different from using a separate flux and wire or bar. With the latter, the flux liquid or paste is first applied, then the solder is heated and flowed onto the metal. When a core solder is used, it is absolutely necessary that the work be heated by the iron or flame. After this, the core solder is in-

troduced to the heated metal, which has been brought up to the liquidius point of the solder, so that the flux can flow onto the job ahead of the molten solder, thereby assuring a permanent bond.

* * *

IF any flux core solder is flowed directly off the soldering iron or if a flame is directed at the solder itself, the flux will be so diffused by the heat of the iron or flame, that none will go onto the metal to be joined. In this case, no bond will result.

* * *

New Spool Finds Ready Acceptance

SALES of more than a million Acropaks are announced by **Acrometal Products, Inc.**, of Minneapolis, Minn., for the first eight months of production. Acropak is the name given by the company to its new spool for wire packaging, drawing and annealing. The spools, which are drawn from aluminum alloy sheet, were among the first precision spools on the market.

* * *

THEIR seven principal advantages are:

1. **Durability. The spools are two or three times as strong as an old style shipping spool and can be used much longer. They cut down reconditioning expense.**
2. **Light weight. They are lighter than steel spools. This reduces shipping costs and the chances of breakage of wire during take-off.**
3. **Annealing quality. They will not warp or undergo dimensional changes when brought to ordinary annealing temperatures. The flanges do not toe out because aluminum has a greater coefficient of expansion than copper. Under repeated annealing operations, these spools will retain their original accuracy.**
4. **Accuracy. Because of their accurate construction, they can be rotated at any desired R.P.M. without vibration. Tolerances are held within .005" on concentricity, flange run-out and traverse. A sharp corner at the junction of the flange and barrel insures even winding, provides even drawing tension, and is designed for end take-off.**
5. **No seams. There are no assembly seams in which fine wire can wedge and be broken. They are turned out like a single piece of metal. The two halves are joined in the center under tremendous pressure. This provides an invisible seal and eliminates possibility of heat distortion.**
6. **Non-corrosive — are corrosion-resistant and can be cleaned easily.**
7. **Attractive — provide eye-appeal in the packaging of wire.**

REELS OF WOOD

RETURNABLE and NON-RETURNABLE

Furnished assembled or knocked down, made to your specifications. Will withstand severest handling. Sturdy, strong, low in cost. Made for

CABLE, ROPE and WIRE

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ALSO, REEL HEADS FOR STEEL DRUMS

Send us your specifications and let us quote on costs.

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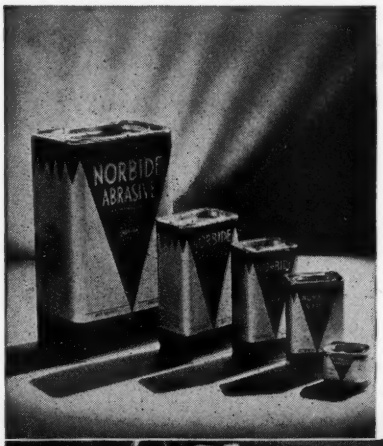
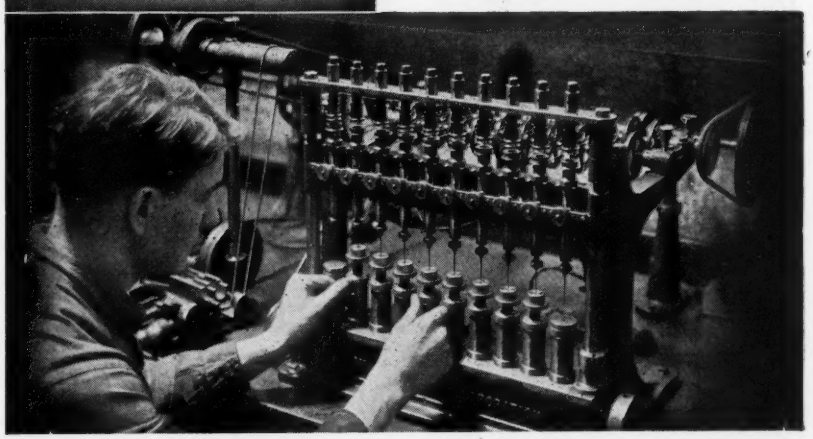


NORBIDE ABRASIVE
For Cemented Carbide Dies

NORBIDE Abrasive is successfully used for cutting and semi-finishing cemented carbide wire drawing dies. This abrasive is second only to diamond powder in hardness and is 150 times less expensive. Sizes 220 and 240 for ripping; 320F for semi-polishing; 500 to 800 for final finishing.

NORTON COMPANY
WORCESTER 6, MASSACHUSETTS



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The *Trauwood* PROCESS

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OUTSTANDING ADVANTAGES

Higher and more uniform physical and fatigue properties.

No surface decarburization or scale.

Faster wire speeds . . . greater production.

Equipment fully automatic and easy to operate.

Control of heating and cooling cycles extremely accurate.

Thermal efficiency of the process very high.

Much finer grained structure possible.

High quenching temperatures rapidly attained.

Adaptable to high alloy and austenitic steel wire and strip (annealing of stainless).

The Trauwood Process, new in principle, eliminates high temperature furnaces and lead pots with their excessive maintenance costs and low thermal efficiencies. More positive temperature control is possible and quenching is done in a RISING temperature—instead of falling, as in conventional heat treating methods. The rapid rate of heating (4 to 5 times as fast as furnace heating) increases production and uniformly produces a finer grained product with higher physical and fatigue values.

Wire and rod patented by the Trauwood Process insures easier drafting and makes heavier reductions possible. In conjunction with the Trauwood patenting equipment, pickling, coating and baking can be made continuous, eliminating expensive handling and delay, materially reducing costs as compared with ordinary methods.

Complete details of the Trauwood Process will be furnished you on request. Our engineers will help you solve your continuous wire and strip patenting, tempering, and annealing problems. Write today.

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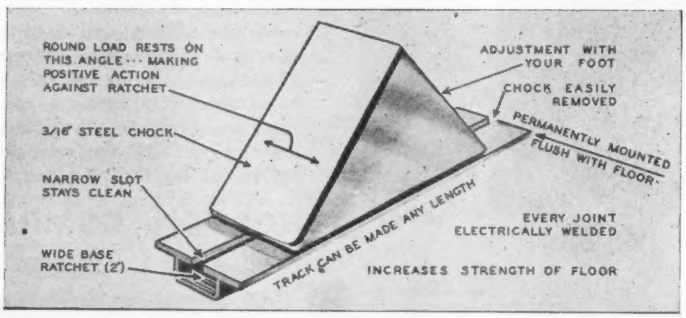
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WIDE BASE RATCHET (2')
ADJUSTMENT WITH YOUR FOOT
CHOCK EASILY REMOVED
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This equipment installed in your trucks and trailers will save time.
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It will save floors; no more driving heavy spikes into the floor.
No more expensive wood chocks to buy. No more nails to buy.
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There is a "Carters Floor Chock", for almost every type load.
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Write for complete details and prices.

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Thermo-Electric-Computing Chart

By Richard L. Fearn

THE graphic chart has been developed to illustrate the relationships of electrical resistance surface area, wire diameter and current carrying capacity of electric conductors of various specific resistance when the conductor is stretched horizontally in free air. These relationships can be useful as a guide in estimating the electrical heating effects of wires formed into coils suspended in various structures or embedded under various conditions.

* * *

IT will be noted that the watts per square inch dissipated by round wire in free air varies inversely with the diameter of the wire. The effects will hold true with helical coils and to some extent to wires embeded in heat conducting solids. By using a table giving the square inches of surface area per foot of length of various sizes of wire, volts per foot can be readily and easily computed from which the length of wire can be found for any desired voltages. The direct relationship between temperature scales, and the watts per square inch, will give watts dissipated by radiation and convection or cylindrical shapes in free air, having surface emission factors of approximately 80% of "Black Body" condition. It will be found that current capacity figures for various alloys given by this chart, will deviate in some cases, from tables issued by resistance wire manufacturers. These irregularities have been checked with results indicating that the tables were in error.

* * *

THIS Chart will be extremely helpful and useful to any engineer designing equipment, where heat is produced electrically in round wires. It can be obtained by mailing $2.00 for each copy desired to **Inventions Sales Company,** 622 Williamson Building, 215 Euclid Avenue, Phone CHerry 7636, Cleveland 14, Ohio.

NOTICE TO SUBSCRIBERS

WIRE & WIRE PRODUCTS BUYERS GUIDE and Year - Book of the Wire Association

The 1948 Edition of this useful directory may be obtained by subscribers at 40% discount from the list price of $5.00 per copy. So when ordering your subscription to WIRE and WIRE PRODUCTS, if you want a copy of the BUYERS GUIDE, please enclose $3.00, or send the order and ask us to bill you. Members of the WIRE ASSOCIATION will continue to receive a copy of the BUYERS GUIDE as part of the service extended to them, and the cost is included in the dues.

To all others the price remains as heretofore $5.00 per copy.

THE BUYERS GUIDE is a complete directory of all kinds of wire and wire products manufactured in the country, together with listings of all machinery, equipment, supplies and services used by the Wire Industry.

It is an invaluable source of information on everything of interest to wire men. Be sure to order your copy early to be certain of getting one, as the edition is limited. Published in Spring annually . . . Only $3.00 to subscribers.

WIRE & WIRE PRODUCTS

300 MAIN ST., STAMFORD, CONN.

Labor Cost Report in Los Angeles Area

LABOR costs in non-ferrous metals and their products face decline in the Los Angeles area, according to a survey issued by the Haynes Foundation.

* * *

TIMED with the resumption of pre-war trends in manufacture, the report is the first analysis of its kind to have been published in the United States. It is entitled "Production Cost Trends in Selected Industrial Areas", and its 249 pages of data, tables and statistics cover the production of all durable and nondurable goods in the cities of Chicago, Los Angeles, Detroit, San Francisco, Pittsburgh, and Cleveland during the decade 1929-1939.

* * *

ONLY paper products and machinery (exclusive of transportation equipment) enjoyed a more favorable position among all manufactures in Los Angeles at the end of the pre-war decade with respect to labor costs.

* * *

THE book is the second of a series on economics sponsored by the Haynes Foundation, and its author is Dr. Philip Neff, Acting Chairman of the Department of Economics, Pomona College. It bears the imprint of the University of California Press.

* * *

New Method for Drilling Small Diamonds

A newly patented arc process for making dies used in the drawing of superfine wire has recently been developed by a five-man team of inventors: C. G. Peters, F. K. Harris, W. B. Emerson, I. L. Cooter and K. F. Nefflen. Rights in the patent are assigned royalty-free to the government.

* * *

HITHERTO the drilling has been accomplished by mechanical means alone, using fine steel needles, with diamond dust as the abrasive. In the new method, this kind of drilling is still used, but in addition a current is fed through the needle, with the diamond embedded in its metal top to complete the circuit.

with HAVEG

If you need a non-metallic material with physicals such as strength, toughness, and durability PLUS 100% corrosion resistance, investigate HAVEG.

This versatile molded material, resistant to chemical action *throughout its entire mass,* is ideal for structural uses. Tanks, towers, and other large structurally strong equipment can be molded in one piece at nominal cost and delivered in from one to eight weeks.

For complete information on how this unusual material can help improve performance and reduce costs on your applications, drop us a line for HAVEG Bulletin F-4.

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If it's twisted folded pressed crushed shaped braided woven paper

TWITCHELL makes it

fine, treated yarns wound 4 ends parallel for high-speed wrapping by new Abbo-sealed process will be available soon.

waxed cable-filler for 2- and 3-wire non-metallic sheath cable and ship-board cable.

wire-rope cores

braiding and wrapping yarns for electrical cable.

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WIRE DRAWING

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$100. Prize for a Best Letter on Industrial Diamond Tools

THE **Industrial Diamond Association of America, Inc.**, offers a First Prize of $100. and a Second Prize of $50. to operators and other shop personnel for a best letter of suggestions for **"Production and Economy Through Industrial Diamonds"**. The Officers and Directors of the Association feel that a service will be rendered to industry in general by the publication in trade journals of shopmen's ideas.

* * *

IT is hoped that journals of the engineering societies and other trade publications will publicize the effort, publish the best and second-best letters, and so stimulate questions from industry. Answers would be prepared either by the named contestants or by the Association.

* * *

THE letter is not restricted as to content, style or length, the idea being to give full freedom to the writer in expressing himself. The only requirement is that the ideas of the writer shall be made clear to all who read them.

* * *

THE judges of the contest will be the Toolmakers and Research Committees of I.D.A. and prominent industrial engineers.

* * *

ANY party interested in writing a letter on "Production Economy Through Industrial Diamonds" is invited to notify:

Athos D. Leveridge,
Executive Manager, I.D.A.
501 Lexington Ave.
New York 17, N. Y.

* * *

THE applicant wil receive a form to return with his competing letter. The form will contain further information.

* * *

To Erect New Headquarters Building

A new headquarters building, to be erected on the largest single plot of land now available on Manhattan Island, was announced

USE THE PROVEN BRAND . . .

Whatever wire product you make, Cortland Brand wire can help you make it better. For wire fabrication of all types, Cortland wire has the right softness or hardness, freedom from surface defects, and correct lubricating properties. There is a Cortland wire in a size and style to fit your requirements.

Cortland BRAND
WICKWIRE BROTHERS, INC., CORTLAND, N. Y.

by the Western Electric Company, manufacturing and supply unit of the Bell System. The site, which was purchased by Western Electric from the Tishman Realty and Construction Co., Inc., comprises a solid area equal to four entire city blocks in the lower Manhattan commerce center, bounded by Varick, Hudson, and Laight Streets and Ericsson Place (formerly Beach Street) and represents a frontage of 440 feet on Varick and Hudson Streets and 405 feet on Ericsson Place and Laight Street.

* * *

Fiberglas Corporation Initiates Approved Service Shop Program

TO make it easier for industrial users of electrical equipment to obtain the advantages provided by Fiberglas-base electrical insulating materials when rewinding motors, generators, transformers, and other electrical equipment, **Owens-Corning Fiberglas Corporation** is offering qualified repair and rewind shops throughout the United States, an opportunity to be designated as providing "Approved Fiberglas Electrical Rewind Service".

* * *

IT is expected that the participating shops will increase their business as a result of being in a better position to service Fiberglas rewind orders. **M. P. Claytor**, of the Fiberglas Corporation's electrical division, who has been working with repair shops and industrial users since 1942, and is coordinating this program from Toledo on a national basis, believes this to be the first time a manufacturer of a basic textile fiber, which is woven and processed into many forms of electrical insulation, has promoted such a plan for expanding its market.

* * *

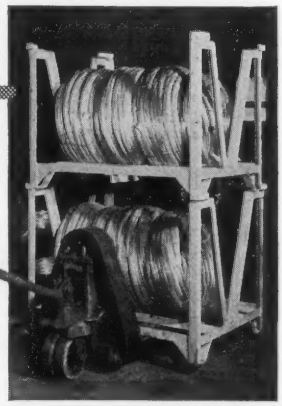
THE Fiberglas Corporation plans initially to enroll enough shops to handle adequately the rewind business in and around all U. S. cities of 100,000 population or more. When this phase of the program has been completed, the program will be expanded to cover shops in all areas where there is a sufficient concentration of industry to warrant one or more approved service shops.

Phone 2-3043

HOWSAM SPOOL COMPANY

500 RATHBONE AVE AURORA ILLINOIS

PALLET RACKS *for the Correct Handling of*
COILED Rod · Flat Strip · Wire . . .
***with* Hand-Lift or Fork-Lift Trucks**
Racks may be used as single units or tiered
Engineered for maximum strength and lightness
Write for full information



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ALL SIZES
WOOD -- PLYWOOD -- WOOD-METAL
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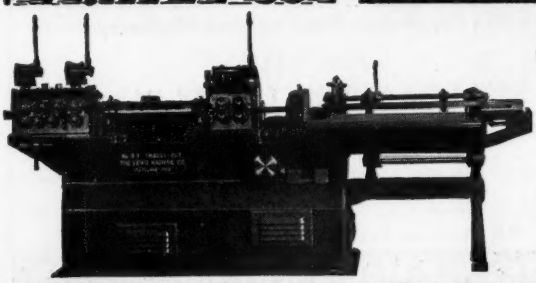
LEWIS TRAVEL-CUT WIRE STRAIGHTENING and CUTTING Machines



Machines for 1/16" to 3/4" rod
Round
Square
Flat
Hexagon
Ferrous and Non-Ferrous

Automatic
High Speed
Heavy Duty

LEWIS

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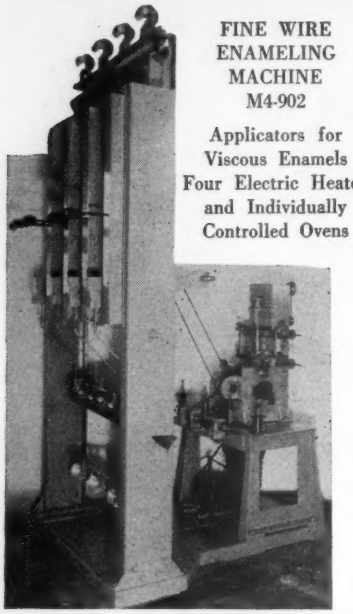

FINE WIRE ENAMELING MACHINE M4-902

Applicators for Viscous Enamels Four Electric Heated and Individually Controlled Ovens

"American" INSULATING MACHINERY COMPANY

517 W. Huntington St.
Philadelphia 33, Penna., U. S. A.

New Bulletin on Moisture Measuring Equipment

A 28-page bulletin, just published by the American Instrument Co., Inc. of Silver Spring, Maryland, gives a comprehensive description of a complete line of electric hygrometer equipment suitable for the more exacting industrial and laboratory applications.

* * *

THE booklet is generously illustrated and lists, among many other devices, a tiny sensing element that responds within a fraction of a second to increases or decreases of relative humidity as small as 0.1%. The booklet explains how this remarkable element measures with an accuracy of within plus-minus 1½% relative humidity, when used with suitable equipment.

* * *

THE electric hygrometer, among other things, can be used for the measurement of electric wire insulation resistance under known relative humidity conditions and the resistance of insulation coatings to fungi, etc., under high humidity conditions.

* * *

FORMER bulletin No. 2140 is superseded by this new bulletin (2164-357) which lists many new, easier to use instruments, in addition to giving data on various industrial and laboratory applications, as well as helpful selection charts, diagrams and calibration curves.

* * *

Wire Rope Five Miles Long

ONE of the longest, flattened, stranded colliery ropes ever made in Britain in one length has been dispatched by **Martin Black and Co.** (Wire Ropes) Ltd., Coatbridge to the William Pit, Whitehaven. The rope almost 5 miles in length, weighs 30 tons 13 cwts. and is 1⅛" diameter.

* * *

THIS particular rope is of interest as indicating a likely trend in production in later years. As production penetrates deeper into the lower stratas, mining concerns will call for ropes designed to meet these new conditions.

* * *

New 32-page Manual on How to Select Industrial Processing Ovens

A new "planning guide for production people concerned with heating, heat treating, baking or curing problems" — purported to be the first manual of its type ever offered to oven users — has just been announced by Gehnrich & Gehnrich, Inc., under the title of "How To Select THE **RIGHT** OVEN FOR **YOUR** PROCESS".

* * *

THE manual discusses the four basically different types of oven heating systems; when to use which; the different heating media; temperature and safety control; insulation; the material-handling problem; interesting ingenuities; the action of different products under heat (chemically, physically, metallurgically, structurally); and the seven basic oven and heater types.

* * *

TYPES of industrial enterprises which will find the new manual

Wire for Modern Production

● Many manufacturing economies are possible with wire specially shaped for particular needs. Whatever your uses or fabricating methods are, there may be a Continental Manufacturers' wire to meet your exact requirements. Continental wire is made in many shapes, sizes and finishes.

CONTINENTAL STEEL CORPORATION

WE BUY WE SELL

We Pay Highest Prices for Used Machinery

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3 NEW ENGLAND BUTT 5-BAY CABLERS

Reel size in cradle 16" x 10" Jute filler accomodation. 38" Capstan and Binder Head. 48" Take-up Stand. Complete Motor, Hoist and Spark Tester.

FOR IMMEDIATE DELIVERY

All Machines Reconditioned in Our Own Shop

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BORAX
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Wire Drawing

After pickling, BORAX can be applied with one dip; dries in three minutes in an oven temperature of 150° F. to provide a coating that will not check or flake off in storage. Dissolves readily in water and is dust free. BORAX, other than being an excellent vehicle for picking up the drawing lubricant, is rust inhibiting and a natural flux that will facilitate the making of good butt welds. Use BORAX to make better wire at less cost. Used in many mills.

Send for complete particulars

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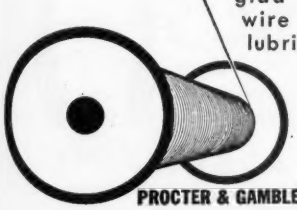
FOR MAXIMUM "MILEAGE" AND FINISH CONTROL IN YOUR WIRE DRAWING OPERATIONS USE P&G SOAPS

For drawing both ferrous and alloy wires—in either dry or wet operations — you can depend upon these important qualities in Procter & Gamble soaps:

Excellent Adherence
Efficient Lubrication
Minimum Dusting
Uniformity
Economy

One of our representatives will be glad to discuss wire drawing lubricants with you.



PROCTER & GAMBLE, CINCINNATI

especially valuable include: foundries, manufacturers of products with baked or cured finishes, meat smokers, heat treaters, producers of cured parts and products (rubber, plastics, building products), textile-coating firms, plastic fabricators, small parts-plating shops, foil producers, and others who use oven equipment operating at temperatures from 250 F to 1150°F.

* * *

REQUESTS for copies should be addressed to Herman Gehnrich, **Gehnrich & Gehnrich, Inc.,** 3232 57th Street, Woodside, L. I., N. Y.

W. T. Ennor, Assistant Research Head For Alcoa

WILLIAM T. Ennor, has been named an assistant director of research for Alcoa's Aluminum Research Laboratories, according to an announcement by Dr. Francis C. Frary, director of research for the company. The new appointment will be effective as of June 1, 1948.

* * *

MR. Ennor has had an outstanding matallurgical career with Alcoa, and has made many significant contributions to the metallurgy of aluminum, including the development of a number of important patented fabricating processes.

Soldering Machine With Specially Designed Electrodes Speeds Production, Cuts Costs, and Eliminates Shrinkage

A production soldering machine that simplifies even the most complicated small hard and soft soldering jobs in the manufacture of jewelry, small products, instruments, and similar items, has been developed by **Joyal Products, Inc.,** Newark, N. J.

ADVERTISING is a service to a magazine's readers. Methods, materials, and machinery were developed under the stress of war. Both editorial matter and advertisements keep you informed on what is happening in industry.

SPOOLS... REELS... BOBBINS

● IF IT CAN be wound on a reel, spool or bobbin, Apco Mossberg can fill your needs.

For over 50 years we have specialized in the manufacture of spools and reels of all kinds. Our plant is equipped to manufacture almost any conceivable kind, type and size of steel spool, reel and bobbin, in large quantities or small.

Write for our brochure containing useful information on a wide variety of our spool and reel products.

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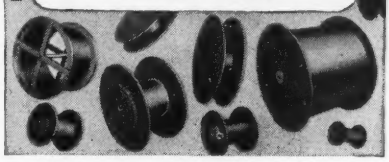
Hugh Williams & Co., 47 Colborne St. Toronto, Ontario, Canada



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CENTRIFUGALLY-CAST FOR QUALITY
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Phosphor Bronze } **WIRE FLAT**
Nickel Silver } **WIRE ROD**

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CORPORATION
Belleville 9, New Jersey

"PLEASE call the Oakite man about that acid inhibitor—That's right! Oakite Pickle Control No. 3 for hot sulphuric. Wonderful stuff! Tell him we need 3 carboys in a hurry. If you don't have his number, send a wire."

OAKITE PRODUCTS, INC.
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OAKITE
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Specialized Industrial Cleaning
MATERIALS • METHODS • SERVICE

IT is particularly applicable for such uses as the assembly of fine parts in jewelry, attaching of finished ornaments, or even soldering after elements are finished without leaving pitting marks. In the jewelry field, the machine has been found to increase production as much as 100 per cent and to cut costs to one-sixteenth of former operations. It is being used by companies such as Speidel and Jacques Kreisler for bracelets, chains, earrings, and baby goods.

* * *

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* * *

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* * *

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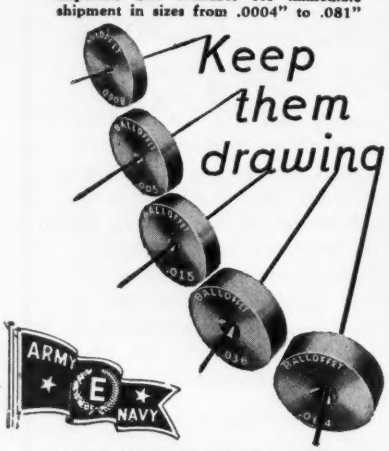

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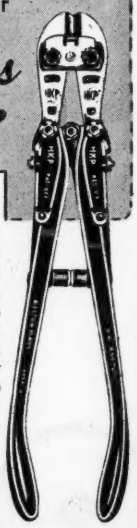

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The Relationship Between Coldworking and Hydrogen Embrittlement

(*Continued from page 478*)

NOW, then, coldwork operates along these same rifts in the imperfection structure, reorganizing and developing them extensively. If the rifts are stuffed with highly compressed gas, coldworking should greatly aid these entrapped pockets to escape from the metal; and it is accordingly true that coldworking removes much hydrogen from the metal. The earliest method of analyzing for hydrogen involved drilling the metal under a liquid[8].

* * *

CONVERSELY, the development of the latent imperfection structure by coldworking should render the metal capable of dissolving much greater total quantities of the gas, just as a preliminary embrittling treatment does; and this is found to be true. Coldworked metal, other factors constant, absorbs much more gas than annealed metal; and this again is qualitatively in accord with the observations of the present paper. Of course, coldworked metal by its very definition has "used up" such a large proportion of the possible slip movements that there is less of the similar type of damage to be done by the hydrogen; and coldworked metal is therefore more rapidly and more completely damaged by hydrogen than annealed metal. This is also borne out by the present tests. The phenomenon is quite comparable to the effect of hardening, to be discussed in a subsequent article, wherein increasing hardness leaves a decreasing proportion of ductile properties to be damaged by the gas.

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The result is a pronounced liability of highly hardened steels to hydrogen embrittlement.

* * *

BY way of direct demonstration of the concept just outlined, we shall return to the microscope technique of "fractography"[9]. Figure 5 discloses a bubble of hydrogen gas trapped in an oil film on a metal photographed in the very act of escape. While the original study[10] should be referred to for experimental details, we have here an annealed piece of steel which was hydrogenized by a cathodic treatment, fractured with a hammerblow, and immediately coated with oil. The fracture face is being viewed directly at high magnification, as described briefly in the first article[1]. The straight markings are the so-called "deformation markings" which disclose the microscopic movement caused by the coldwork. The bubbles of hydrogen gas burst out of the metal at the site of these markings, proving the mutual habitat of hydrogen occlusion and coldwork. Also, the bubbles appeared suddenly, at full size, indicative of their preexistence as an entrapment in this plane of looseness.

* * *

Conclusions

FROM this study the following conclusions can be drawn regarding the interrelationships of coldwork and hydrogen embrittlement.

1. Both the mechanical movements of coldwork and the precipitation of hydrogen within steel operate along planes of looseness within the grain of the metal;
2. Both coldwork and hydrogen act to open and develop the latent looseness structure of annealed metal. Their action in this respect is cooperative;
3. Coldworking therefore increases the capacity of the metal for absorbing hydrogen; and its own act of exhausting a proportion of the available slip movements leaves the metal more liable to embrittlement from hydrogen;
4. In some grades, rough handling of coils in the mill can introduce sufficient coldwork in local portions of the wire to cause extreme liability to embrittlement in subsequent pickling operations;
5. Removing the effects of coldwork by annealing renders the metal more resistant to hydrogen embrittlement; and very careful annealing treatments can be especially effective;
6. Coldworking a metal already containing hydrogen causes removal of much of the gas by opening communications among the individual gas occlusions and allowing them, aided by the

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compression of the coldwork, to force their way to the surface and escape; 7. Other factors being equal, embrittlement develops more rapidly, and probably more severely, at higher pickling temperatures, even for cathodic pickling where metal attack is not concerned.

* * *

Acknowledgment

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(*Continued from page* 492)

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Scudder, E. J., Foundry & Machine Co., Trenton, N. J.

ARMORING EQUIPMENT—
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machy, Inc., Pawtucket, R. I.

BAKERS—Rod and Wire
Carl-Mayer Corp., The, Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
Ross, J. O., Engr. Corp., New York, N. Y.

BAR STOCK—Stainless Steel
Armco Steel Corp., The, Middletown, Ohio.
American Steel & Wire Company, Cleveland, Chicago, New York.
Columbia Steel Co., San Francisco, Calif.
U. S. Steel Export Company, New York, N. Y.

BENDERS—
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

BOBBINS—Braider & Wire Weaving
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

BORAX—Wire Drawing
Pacific Coast Borax Corp., New York, N. Y.

BORON CARBIDE—
Norton Co., Worcester, Mass.

BRAKES—Pneumatic
Entwistle, Jas. L. Co., Pawtucket, R. I.

BRAKES & SHEARS—
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

CABLE LACQUERING OVENS—
Industrial Ovens, Inc., Cleveland, O.

CARRIERS—Braider, High Speed
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

CASTINGS—Wire Mill
Scudder, E. J. Fdry. & Mach. Co., Trenton, N.J.

CEMENTS—Acid Proof
Sauereisen Cements Co., Pittsburgh, Pa.

CEMENTS—Refractory
Norton Co., Worcester, Mass.
Sauereisen Cements Co., Pittsburgh, Pa.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., Pittsburgh, Pa.
Standard Industrial Compounds Co., Chicago, Ill.

CLEANERS—Hand and Metal
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Phila, Pa.
Magnus Chemical Co., Garwood, N. J.
Metal & Thermit Corp., New York, N. Y.
Nopco Chemical Co., Harrison N. J.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

CLEANING & PICKLING EQUIP.—
Cleveland Tramrail Div., of the Cleveland Crane & Engineering Co., Wickliffe, O.
Haveg Corp., Newark, Del.
Metal & Thermit Corp., New York, N. Y.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp, Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

CLOTH TESTERS—
Scott Testers, Inc., Providence, R. I.

CLOTH—WIRE, All Metals
Roebling's, John A. Sons, Co., Trenton, N. J.
Wickwire Spencer Steel Division, Colorado Fuel & Iron Corp., Buffalo, N. Y.

COATING COMPOUNDS—
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

COILERS—Sheet, Strip and Wire
Entwistle, Jas. L. Co., Pawtucket, R. I.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J. Machine Co., Newark, N. J.
Wean Equipment Corp., Cleveland, Ohio.

COLD HEADERS—
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

COMPOUNDS—Coppering
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Diamond
Magnus Chemical Co., Garwood, N. J.
Engis Equipment Co., Chicago, Ill.

COMPOUNDS—Metal Finishing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.

COMPOUNDS—Rust Preventing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Nopco Chemical Co., Harrison N. J.
Oakite Products, Inc., New York, N. Y.

COMPOUNDS—Rust Removing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

COMPOUNDS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H. Co., Inc., Homer, N. Y.
Nopco Chemical Co., Harrison N. J.
Oakite Products, Inc., New York, N. Y.
Pacific Coast Borax Corp., New York, N. Y.
Potter, Neil C., Newark, N. J.
Standard Industrial Compounds Co., Chicago, Ill.
Swift & Company, Chicago, Ill.

COPHOLDERS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Wire & Textile Machinery Inc., Pawtucket, R.I.

CRANES—Wire Mill
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUTTING TOOLS—Carbide
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.
Metal Carbides Corporation, Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, New York.
Vascoloy-Ramet Corp., North Chicago, Ill.
Willey's Carbide Tool Co., Detroit, Mich.

CUTTING TOOLS—Wire
Porter, H. K., Inc., Everett, Mass.

DIAMONDS—Industrial
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Champion Diamond Co., New York, N. Y.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND POWDERS—
Champion Diamond Co., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND TOOLS—
Carboloy Co., Inc., Detroit, Mich.
Eastern Tungsten Carbide Co., Newark, N. J.
Firth Sterling Steel & Carbide Co., McKeesport, Pa.
Metal Carbides Corporation, Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Cold Heading
Hoosier Carbide Die Co., Ft. Wayne, Ind.

DIES—Diamond
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Cochaud Wire Die Corp., New York, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Eyelet
Hoosier Carbide Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.

DIES—Lead Extrusion
Carboloy Co., Inc., Detroit, Mich.
Eastern Tungsten Carbide Co., Newark, N. J.
Firth Sterling Steel & Carbide Co., McKeesport, Pa.
Metal Carbides Corporation, Youngstown, Ohio.
Robertson, John, Co., Brooklyn, N. Y.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Repairs & Re-Cutting
Ajax Industrial Supplies Inc., Fort Wayne, Ind.
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Carboloy Co., Detroit, Mich.
Cochaud Wire Die Corp., New York, N. Y.
Eastern Tungsten Carbide Co., Newark, N. J.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Rod and Tube Drawing
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Carboloy Co., Inc., Detroit, Mich.
Eastern Tungsten Carbide Co., Newark, N. J.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Sintered Carbide
Hoosier Carbide Die Co., Ft. Wayne, Ind.

DIES—Special Shapes, Etc.
Hoosier Carbide Die Co., Ft. Wayne, Ind.

DIES—Tantalum Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.

DIES—Tubing
Hoosier Carbide Die Co., Ft. Wayne, Ind.

DIES—Tungsten Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.
Hoosier Carbide Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, Ohio.
Rusch Wire Die Corp. Croton-on-the-Hudson, N.Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DRAW BENCHES—
(See MACHINERY—Draw Benches)

DRUMS—Flange Steel
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.
Watson Machine Co., The, Paterson, N. J.

DRYING EQUIPMENT—
Carl-Mayer Corp., The, Cleveland, Ohio.
Industrial Ovens, Inc., Cleveland, Ohio.
Ross, J. O., Engineering Corp., New York, N.Y.

WHERE TO BUY, Continued

ENGINEERS—Consulting Wire Mill
Lewis, Kenneth B., Worcester, Mass.

EQUIPMENT—Insulation Testing
Davis, R. L., Elec. Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.

EYELETS—Brass or Zinc
Platt Bros., & Co., The, Waterbury, Conn.

FLUXES—Soldering
American Chemical Paint Co., Ambler, Pa.

FOAM PRODUCING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Parkin, Wm. M. Co., Pittsburgh, Pa.

FRICTION PAY-OFF STANDS—
Industrial Ovens, Inc., Cleveland, Ohio.

FURNACES—Annealing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Hayes C. I., Providence, R. I.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engr. Co., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Automatic
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Brazing
Electric Furnace Co., Salem, Ohio.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, Ohio.
Furnace Engineers Inc., Pittsburgh, Pa.
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Electric
Eisler Engineering Co., Newark, N. J.
Electric Furnace Co., Salem, Ohio.
Hayes, C. I., Providence, R. I.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio

FURNACES—Galvanizing Equipment
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Hard'ing & Temp'ing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engr. Co., The, Cleveland, Ohio.

FURNACES—Lead Melting
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Robertson, John, Co., Brooklyn, N. Y.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Non-Oxidizing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Normalizing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Pot (Oil, Gas, Electric)
Ajax Electric Co., Inc., Philadelphia, Pa.

FURNACES—Resistance Healing, Strand
Trauwood Engineering Co., Cleveland, Ohio

FURNACES—Salt Bath
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio.
Surface Combustion Corporation, Toledo, O.
Trauwood Engineering Co., The, Cleveland, Ohio

FURNACES—Wire, Strip & Sheet
Carl-Mayer Corp., The, Cleveland, Ohio.
Eisler Engineering Co., Newark, N. J.
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Surface Combustion Corporation, Toledo, O.
Trauwood Engineering Co., The, Cleveland, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio.

GALVANIZING ENGINEER—Consulting
Spowers, W. H., Jr., New York, N. Y.

GALVANIZING EQUIPMENT—
Hanson-Van Winkle-Munning Co., Matawan, N.J.
Steel Equipment Co., Cleveland, Ohio.
Wean Equipment Corp., Cleveland, Ohio.

GAVANIZING FLUXES—
Hanson-Van Winkle-Munning Co., Matawan, N.J.

GALVANIZING KETTLES—
National Annealing Box Co., Washington, Penna.

GRINDERS—Roll
Norton Co., The, Worcester, Mass.

HOISTS—Electric Travelling
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, Ohio.

INHIBITORS—Pickling
American Chemical Paint Co., Ambler, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M. Co., Pittsburgh, Pa.

INSULATING LACQUERING SYSTEMS—Continuous
American Insulating Machine Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.

INSULATING MATERIALS—
Du Pont de Nemours, E. I., Co., Wilmington, Del.
General Electric Co., Schenectady, N. Y.
Martin, Glenn L. Company, Baltimore, Md.
Owens Corning Fiberglas Corp., Toledo, O.
Standard Varnish Wks., Staten Island, N. Y.
Twitchell, E. W., Philadelphia, Pa.
Warren Thread Works, Inc., W., New York, N.Y.

LATHES—Die Reaming
Carboloy Co., Inc., Detroit, Mich.
Firth Sterling Steel & Carbide Co., McKeesport, Pa.
Morgan Construction Co., Worcester, Mass.
Roos, H. & G., Tool & Mfg. Co., Montclair, N.J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

LIME—
Warner Co., Philadelphia and Bellefonte, Pa.

LININGS—Acid and Alkali Proof
Haveg Corp., Newark, Del.
Sauereisen Cements Co., Pittsburgh, Pa.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

LUBRICANTS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Potter, Neil C., Newark, N. J.
Standard Industrial Compounds Co., Chicago, Ill.
Swift & Company, Chicago, Ill.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Wire & Textile Mach'y, Inc., Pawtucket, R. I.

MACHINERY—Brazing
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Bunching
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Nilson, A. H. Machine Co., The, Bridgeport, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cable, Rope Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Entwistle, Jas. L. Co., Pawtucket, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Collers
Eisler Engineering Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (used), New York, N. Y.
New England Butt Co., Providence, R. I.
Ruesch, H. J. Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.
Wire & Textile Machinery Inc., Pawtucket, R. I.

MACHINERY—Copper Wire Drawing and Rolling
Aetna Standard Eng'g Co., The, Youngstown, O.
American Insulating Mach'y Co., Phila., Pa.
National Machinery Exchange (used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire
American Insulating Mach'y Co., Phila., Pa.
National Rubber Machinery Co., Akron, Ohio
National Erie Corp., Erie, Pa.
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cutting
Eisler Engineering Co., Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio.
National Mach'y Exch. (Used), New York, N.Y.
Nilson Machine Co., A. H., Bridgeport, Conn.
Porter, H. K. Inc., Everett, Mass.
Shuster, F. B. Mfg. Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Die Making
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Roos, H. & G., Tool & Mfg. Co., Montclair, N.J.
Wayne Wire Die Co., Hillside, N. J.

MACHINERY—Draw Benches
Aetna Standard Eng'g Co., The, Youngstown, O.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Edging
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.

WHERE TO BUY, Continued

MACHINERY—Extruding
National Erie Corp., Erie, Pa.
National Rubber Machinery Co., Akron, Ohio.
Robertson John, Co., Brooklyn, N. Y.
Royle, John, & Sons, Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R. I

MACHINERY—Fence
Glader, Wm., Machine Works, Chicago, Ill.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Filament Coil Winding
Eisler Engineering Co., Newark, N. J.

MACHINERY—Flat Wire
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Wire Forming
Eisler Engineering Co., Newark, N. J.
National Mach'y Exch. (Used), New York, N.Y.
Nilson Machine Co., A. H., Bridgeport, Conn.
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.
Reed & Richards, Transatlantic, Inc., New York,
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Galvanizing
(See Galvanizing Equipment)

MACHINERY—Galvanizing Wire
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

MACHINERY—Gang Winders
Entwistle, Jas. L. Co., Pawtucket, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

MACHINERY—Insulating
American Insulating Mach'y Co., Phila., Pa.
National Erie Corp., Erie, Pa.
National Rubber Machinery Co., Akron, Ohio.
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lead Encasing Presses, etc.
Robertson, John Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
Robertson, John Co., Brooklyn, N. Y.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Material Handling
Cleveland Tramrail, Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.
Fab-Weld Corporation, Philadelphia, Pa.

MACHINERY—Measuring Wire & Cable
Durant Mfg. Co., Milwaukee, Wis.
Entwistle, Jas. L. Co., Pawtucket, R. I.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works, Chicago, Ill.
National Mach'y Exch. (Used), New York, N.Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Panning
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Perth Amboy, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Plating Electrolytic
Hanson-Van Winkle-Munning Co., Matawan, N.J.

MACHINERY—Pointing
Aetna Standard Eng'g Co., The, Youngstown, O.
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry & Mach. Co., Trenton, N.J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MATERIAL—Resistance Heating Strand
Trauwood Engineering Co., Cleveland, Ohio.

MACHINERY—Rod Mill
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Rolling Mill
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Rubber Insulating
National Rubber Machinery Co., Akron, O.
Royle, John & Sons, Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R. I.

MACHINERY—Rubber Tubing and Straining
National Rubber Machinery Co., Akron, O.
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Screw Wire
National Mach'y Exch. (Used), New York, N.Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila., Pa.
Emory, Robert J., Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
National Erie Corporation, Erie, Pa.
New England Butt Co., Providence, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry & Mach. Co., Trenton, N.J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Spooling
American Insulating Mach'y Co., Phila., Pa.
Eisler Engineering Co., Newark, N. J.
Emory, Robert J., Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
National Mach'y Exch. (Used), New York, N.Y.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O. Waterbury, Conn.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.
Wire & Textile Mach'y, Inc., Pawtucket, R. I.

MACHINERY—Spring Making
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Lewis Machine Co., The, Cleveland, Ohio.
National Mach'y Exch. (Used), New York, N.Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.
Shuster, F. B., Mfg. Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Stranding
Hughesville Machine & Tool Co., Hughesville, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Ruesch, H. J., Machine Co., Newark, N. J.
Steel Equipment Co., Cleveland, Ohio.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Swaging
National Erie Corp., Erie, Pa.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Testing Physical
American Optical Co., Buffalo, N. Y.
Scott Testers, Inc., Providence, R. I.

MACHINERY—Testing Equipment—Sparkers
Davis, R. L. Elec. Co., Wallingford, Conn.
Entwistle, Jas. L., Pawtucket, R. I.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Tinning Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Steel Equipment Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila, Pa.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
National Erie Corp., Erie, Pa.
Ruesch, H. J., Machine Co., Newark, N. J.

MACHINERY—Welding Wire
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Winding
American Insulating Mach'y Co., Phila, Pa.
Eisler Engineering Co., Newark, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wind-up (Constant Tension, Variable Speed)
Aetna Standard Eng'g Co., The, Youngstown, O.
Industrial Ovens, Inc., Cleveland, Ohio.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Bending
Eisler Engineering Co., Newark, N. J.
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

MACHINERY—Wire Drawing
Aetna Standard Eng'g Co., The, Youngstown, O.
American Insulating Mach'y Co., Phila., Pa.
Eisler Engineering Co., Newark, N. J.
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wood Screw
National Mach'y Exch. (Used), New York, N.Y.

MATERIAL HANDLING EQUIPMENT
Carters Industries, Anderson, Indiana.
Cleveland Tramrail, Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.
Fab-Weld Corporation, Philadelphia, Pa.

NAILS—Wire
American Steel & Wire Co., Cleveland, Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling, John A. Sons Co., Trenton, N. J.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.
U. S. Steel Export Co., New York, N. Y.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Chase Brass & Copper Co., Waterbury, Conn.
Eastwood-Nealley Corp., Belleville, N. J.
Hudson Wire Co., Ossining, N. Y.

WHERE TO BUY, Continued

OPTICAL EQUIPMENT—Metallurgical
American Optical Co., Buffalo, N. Y.

OVENS—Cable Lacquering
American Insulating Mach'y Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.

OVENS—Dehydrogenizing
Carl-Mayer Corp., The, Cleveland, Ohio.
Industrial Ovens, Inc., Cleveland, Ohio.

OVENS—Industrial
Carl-Mayer Corp., The, Cleveland, Ohio.
Industrial Ovens, Inc., Cleveland, Ohio.
Ross, J. O., Engr. Corp., New York, N. Y.

OVENS—Welding Rod Coating
Carl-Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio.
Ross, J. O., Engr. Corp., New York, N. Y.

PAINTS—Heat Resisting
American Chemical Paint Co., Ambler, Pa.

PANS—Lead and Spelter
National Annealing Box Co., Washington, Penna.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Creped Wrapping
Crepe-Kraft Co., Newark, N. J.

PAPER—For Coil Wrapping and Corrosion Prevention
Crepe-Kraft Co., Newark, N. J.

PAPER TESTERS—
Scott Testers, Inc., Providence, R. I.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D.C.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., Pittsburgh, Pa.

PICKLING—Hooks, etc. Acid Resisting
Gordon, Clark E., Detroit, Mich.

PICKLING TANK LININGS—
Haveg Corp., Newark, Del.
Sauereisen Cements Co., Pittsburgh, Pa.

PIPES & FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

PLASTIC TESTERS—
Scott Testers, Inc., Providence, R. I.

PLATING PROCESS—Electrolytic
Hanson-Van Winkle-Munning Co., Matawan, N.J.

POTS—Lacquer
Industrial Ovens, Inc., Cleveland, Ohio

POTS—Lead Melting
National Annealing Box Co., Washington, Pa.
Robertson, John, Co., Brooklyn, N. Y.

POWDER—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Potter, Neil C., Newark, N. J.
Standard Industrial Compounds Co., Chicago, Ill.

PRESSES—Hydraulic and Mechanical
Robertson, John, Co., Brooklyn, N. Y.

PRESSES—Lead
Robertson, John, Co., Brooklyn, N. Y.

PRESSURE VESSELS—
National Annealing Box Co., Washington, Penna.

PULLERS—Wire
Scudder, E. J., Fdry. & Mach. Co., Trenton, N.J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
Robertson, John, Co., Brooklyn, N. Y.

REEL AND TENSION STANDS—
Davis, R. L. Electric Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.
Industrial Ovens, Inc., Cleveland, Ohio.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Collapsible
Entwistle, Jas. L. Co., Pawtucket, R. I.

REELS—Steel
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS AND SPOOLS—Shipping and Shop
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg., Co., The, Hazardville, Conn.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Takeoff
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., Hazardville, Conn.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Mfg. Co., New Haven, Conn.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Vulcanizing & Impregnating
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Wire Drawing
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Wire Mill
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Mfg. Co., New Haven, Conn.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Wooden
Bridge Mfg. Co., Inc., The, Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.

REFRACTORIES—High Temperature
Norton Company, Worcester, Mass.

RESISTANCE HEATING—Annealing, Patenting, Etc.
Trauwood Engr. Co., Cleveland, Ohio.

ROD BAKERS—
Carl-Mayer Corp., The, Cleveland, Ohio.
Ross, J. O., Engineering Corp., New York, N.Y.

RODS—Nickel Alloy
Eastwood Nealley Corp., Belleville, N. J.
International Nickel Co., Inc., New York, N.Y.

RODS—Stainless Steel
Armco Steel Corp., The Middletown, Ohio

RODS—Wire—Non-Ferrous
Eastwood-Nealley Corp., Belleville, N. J.
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire, Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's John A., Sons Co., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

ROPE—Wire
American Steel & Wire Company, Cleveland, Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Roebling's, John A., Sons Co., Trenton, N. J.
U. S. Steel Export Co., New York, N. Y.
Wickwire-Spencer Steel, Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.

RUBBER AND RUBBER COMPRESSION TESTERS—
Scott Testers, Inc., Providence, R. I.

RUST PROOF COMPOUNDS—
(See Compounds—Rust Preventing)

RUST REMOVING COMPOUNDS—
(See Compounds—Rust Preventing)

SATURATION SYSTEMS—
Industrial Ovens, Inc., Cleveland, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machy, Inc. Pawtucket, R. I.

SHEARS—
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

SHEET—Steel
Armco Steel Corp., The Middletown, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A., Sons Co., Trenton, N. J.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

SOAPS—Industrial and Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H. Co., Inc., Homer, N. Y.
Nopco Chemical Co., Harrison N. J.
Potter, Neil C., Newark, N. J.
Procter & Gamble, Cincinnati, Ohio.
Swift & Company, Chicago, Ill.

SOLVENT RESIN SYSTEMS—Experimental
Industrial Ovens, Inc., Cleveland, Ohio.

SPOOLS—Annealing and Wire Drawing
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Company, Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

SPOOLS—Shipping and Shop
Apco Mossberg Co., Attleboro, Mass.
Clark Mfg. Co., J. L., Rockford, Ill.
Howsam Spool Company, Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp.,

SPOOLS—Steel
Apco Mossberg Co., Attleboro, Mass.
Clark Mfg. Co., J. L., Rockford, Ill.
Howsam Spool Company, Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

STAMPINGS—Steel
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Brass and Non-Ferrous
Chase Brass & Copper, The Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.

STRIP—Steel
Armco Steel Corp., The Middletown, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth Sterling Steel & Carbide Co., McKeesport, Pa.
Roebling's, John A., Sons Co., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

SWIFTS—Take-off
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Watson Machine Co., Paterson, N. J.

WHERE TO BUY, Continued

TANK—Compound
Haveg Corp., Newark, Del.
Watson Machine Co., Paterson, N. J.

TANKS—Pickling
Haveg Corp., Newark, Del.
Sauereisen Cements Co., Pittsburgh, Pa.

TANKS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.
National Annealing Box Co., Washington, Penna.

TINSEL—Cords, Decorative
Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TINSEL—Electric Conductor
Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TINSEL—Electric Resistance
Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TINSEL—Lame, Silver and False Gold
Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TINSEL—Thread, Silver and False Gold
Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TINSEL—Thread, Decorative
Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TOOLS—Wire Cutting
Porter, H. K., Inc., Everett, Mass.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

TRAVERSES—For Reels
Entwistle, James L. Co., Pawtucket, R. I.
Hubbard Spool Company, Chicago, Ill.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

TRAVERSE MECHANISMS—
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machy, Inc. Pawtucket. R. I.

TUBE BENDERS AND FORMERS—
O'Neil-Irwin Mfg. Co., Lake City, Minn.
Ruesch, H. J. Machine Co., Newark, N. J.

VALVES AND FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

VARNISHES—For Insulation
General Electric Co., Schenectady, N. Y.
Standard Varnish Wks., Staten Island, N. Y.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.
Sciaky Bros., Inc., Chicago, Ill.

WIND-UP AND UNWIND SYSTEMS—Continuous
American Insulating Mach'y. Co., Phila., Pa.
Davis, R. L. Electric Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.
Industrial Ovens, Inc., Cleveland, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machy, Inc. Pawtucket, R. I.

WIRE—Aluminum
Aluminum Co. of America, Pittsburgh, Pa.
Malin & Co., Cleveland, Ohio.

WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Cold Heading
Armco Steel Corp., The Middletown, Ohio
American Steel & Wire Co., Cleveland-Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's John A., Sons Co., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Electric
Chase Brass & Copper, The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Malin & Co., Cleveland, Ohio.

WIRE—Enameled for Coils
North American Philips Co., Inc., New York, N.Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Armco Steel Corp., The Middletown, Ohio
American Steel & Wire Co., Cleveland-Chicago & New York.
Bethlehem Steel Co., Bethlehem, Pa.
Chase Brass & Copper, The, Waterbury, Conn.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A., Sons Co., Trenton, N. J.
Tennessee Coal, Iron & R. R. Co., Birmingham, Ala.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., of Colorado Fuel & Iron Corp., Buffalo, N.Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Nickel & Nickel Alloy
Eastwood-Nealley Corp., Belleville, N. J.
International Nickel Co., Inc., New York, N. Y.

WIRE—Music
American Steel & Wire Co., Cleveland, Chicago-New York.
Columbia Steel Co., San Francisco, Calif.
Ecca Machine Corp., New York, N. Y.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., Cleveland, Ohio.
Paramount Wire Co., New York, N. Y.
U. S. Steel Export Co., New York, N. Y.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.

WIRE—Nickel Silver and Phosphor Bronze
Chase Brass & Copper, The, Waterbury, Conn.
Eastwood-Nealley Corp., Belleville, N. J.
Hudson Wire Co., Ossining, N. Y.
Malin & Co., Cleveland, Ohio.

WIRE—Non-Ferrous to Specification for Special Purposes
Chase Brass & Copper, The, Waterbury, Conn.
Eastwood-Nealley Corp., Belleville, N. J.
Hudson Wire Co., Ossining, N. Y.
North American Philips Co., Inc., New York, N.Y.
Paramount Wire Co., New York, N. Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRESERVING—Paper and Cotton
Paramount Wire Co., New York, N. Y.

WIRE—Spring
Armco Steel Corp., The Middletown, Ohio
American Steel & Wire Co., Cleveland - Chicago
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp, Kokomo, Indiana.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Keystone Steel & Wire Co., Peoria, Ill.
U. S. Steel Export Co., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Stainless Steel
Armco Steel Corp., The Middletown, Ohio
American Steel & Wire Co., Cleveland-Chicago-New York.
Columbia Steel Co., San Francisco, Calif.
Firth Sterling Steel & Carbide Co., McKeesport, Pa.
Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.
U. S. Steel Export Co., New York, N. Y.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Firth Sterling Steel & Carbide Co., McKeesport, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Keystone Steel & Wire Co., Peoria, Ill.
Paramount Wire Co., New York, N. Y.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Straightening and Cutting—
Pittsburgh Cut Wire Co., Pittsburgh, Pa.

WIRE—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

WIRE CLOTH—Industrial
Roebling's John A., Sons Co., Trenton, N. J.
Wickwire Brothers, Cortland, N. Y.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.

WIRE TESTERS—
Scott Testers, Inc., Providence, R. I.

WIRE, WEAVING—Non-Ferrous
Chase Brass & Copper Co., The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Paramount Wire Co., New York, N. Y.

WRAPPING PAPER—Creped
Crepe-Kraft Co., Newark, N. J.

YARNS & TAPES—
Du Pont de Nemours, E. I., Co., Wilmington, Del.
General Electric Co., Schenectady, N. Y.
Owens Corning Fiberglas Corp., Toledo, Ohio.
Twitchell, E. W., Philadelphia, Pa.
Warren Thread Works, Inc., W., New York, N.Y.

YARN TESTERS—
Scott Testers, Inc., Providence, R. I.

USE- - - - -

WIRE and WIRE PRODUCTS — A Good Advertising Medium —

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ESTABLISHED 1845
PATERSON 3, NEW JERSEY, U. S. A.

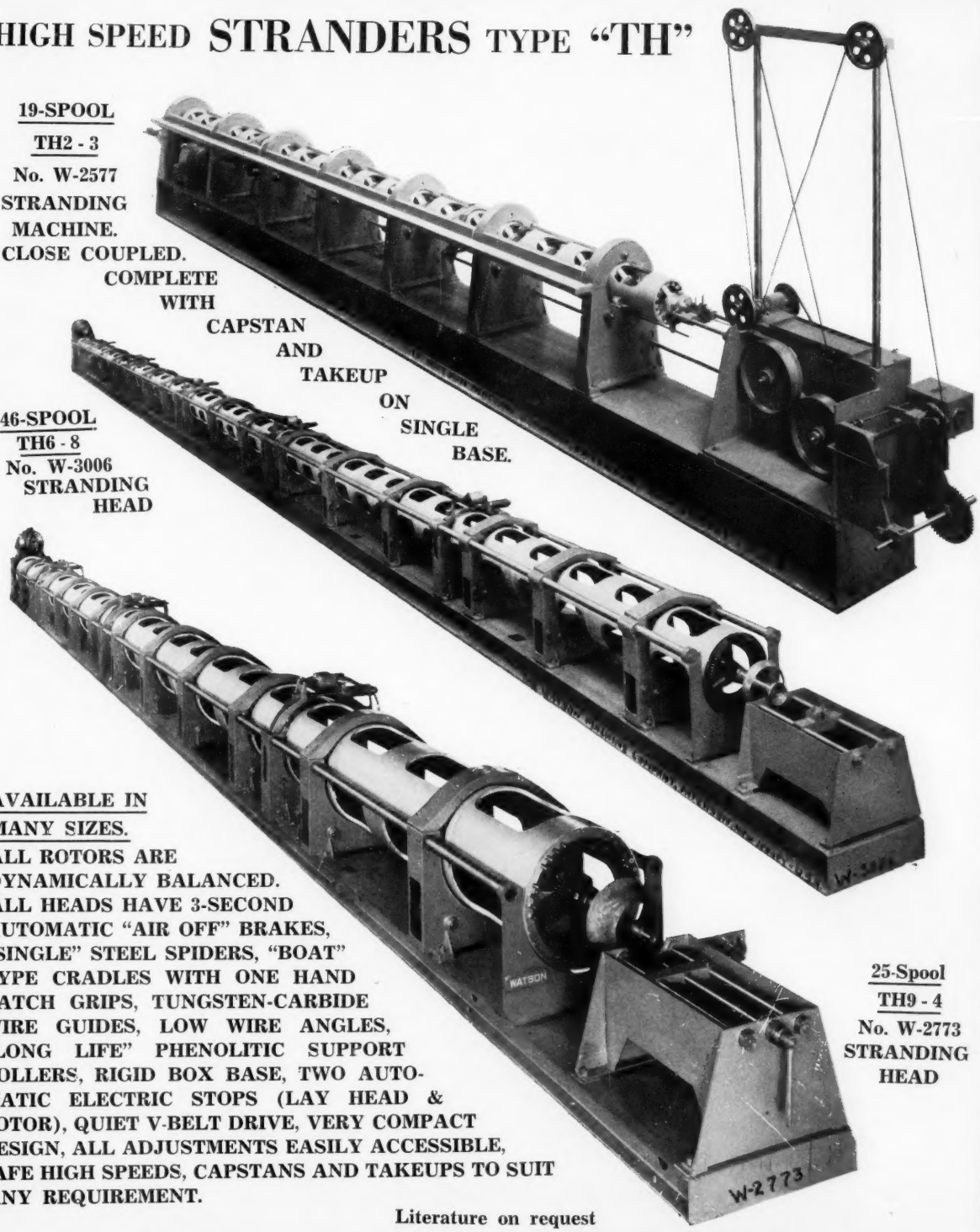
Wire & Wire Products
June, 1948

ELECTRICAL WIRE AND CABLE, WIRE ROPE AND CORDAGE MACHINERY

HIGH SPEED STRANDERS TYPE "TH"

19-SPOOL
TH2 - 3
No. W-2577
STRANDING MACHINE.
CLOSE COUPLED. COMPLETE WITH CAPSTAN AND TAKEUP ON SINGLE BASE.

46-SPOOL
TH6 - 8
No. W-3006
STRANDING HEAD



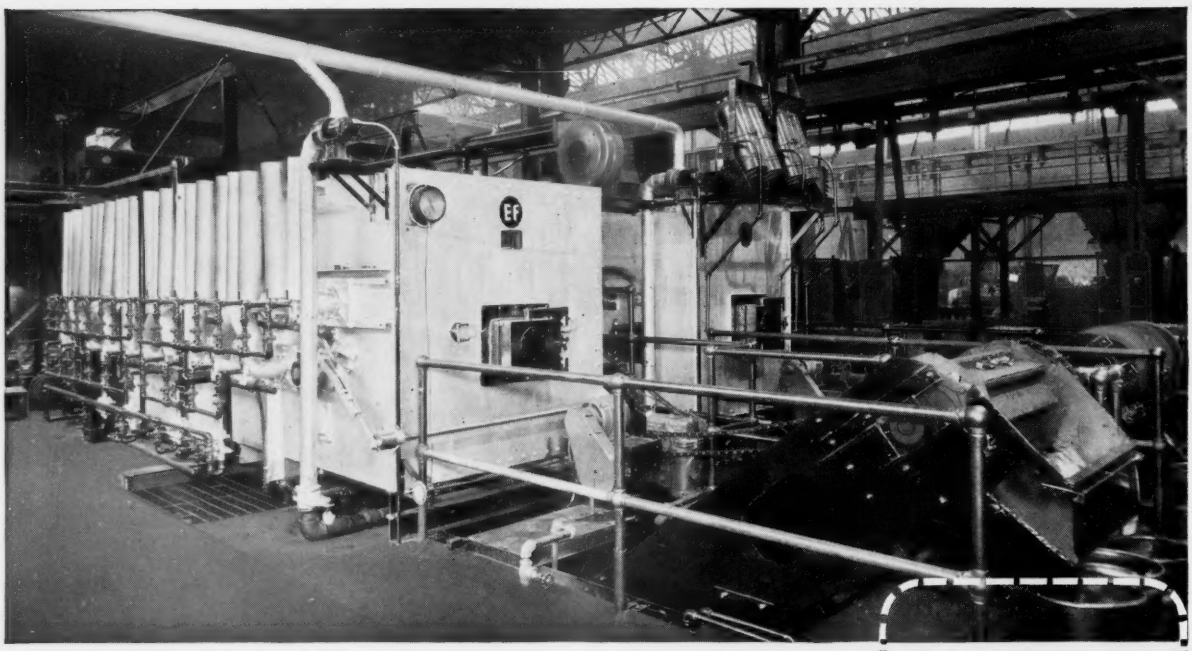
25-Spool
TH9 - 4
No. W-2773
STRANDING HEAD

AVAILABLE IN MANY SIZES.
ALL ROTORS ARE DYNAMICALLY BALANCED. ALL HEADS HAVE 3-SECOND AUTOMATIC "AIR OFF" BRAKES, "SINGLE" STEEL SPIDERS, "BOAT" TYPE CRADLES WITH ONE HAND LATCH GRIPS, TUNGSTEN-CARBIDE WIRE GUIDES, LOW WIRE ANGLES, "LONG LIFE" PHENOLITIC SUPPORT ROLLERS, RIGID BOX BASE, TWO AUTOMATIC ELECTRIC STOPS (LAY HEAD & ROTOR), QUIET V-BELT DRIVE, VERY COMPACT DESIGN, ALL ADJUSTMENTS EASILY ACCESSIBLE, SAFE HIGH SPEEDS, CAPSTANS AND TAKEUPS TO SUIT ANY REQUIREMENT.

Literature on request

EF

STANDARD DESIGNS OF CHAIN BELT FURNACES



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